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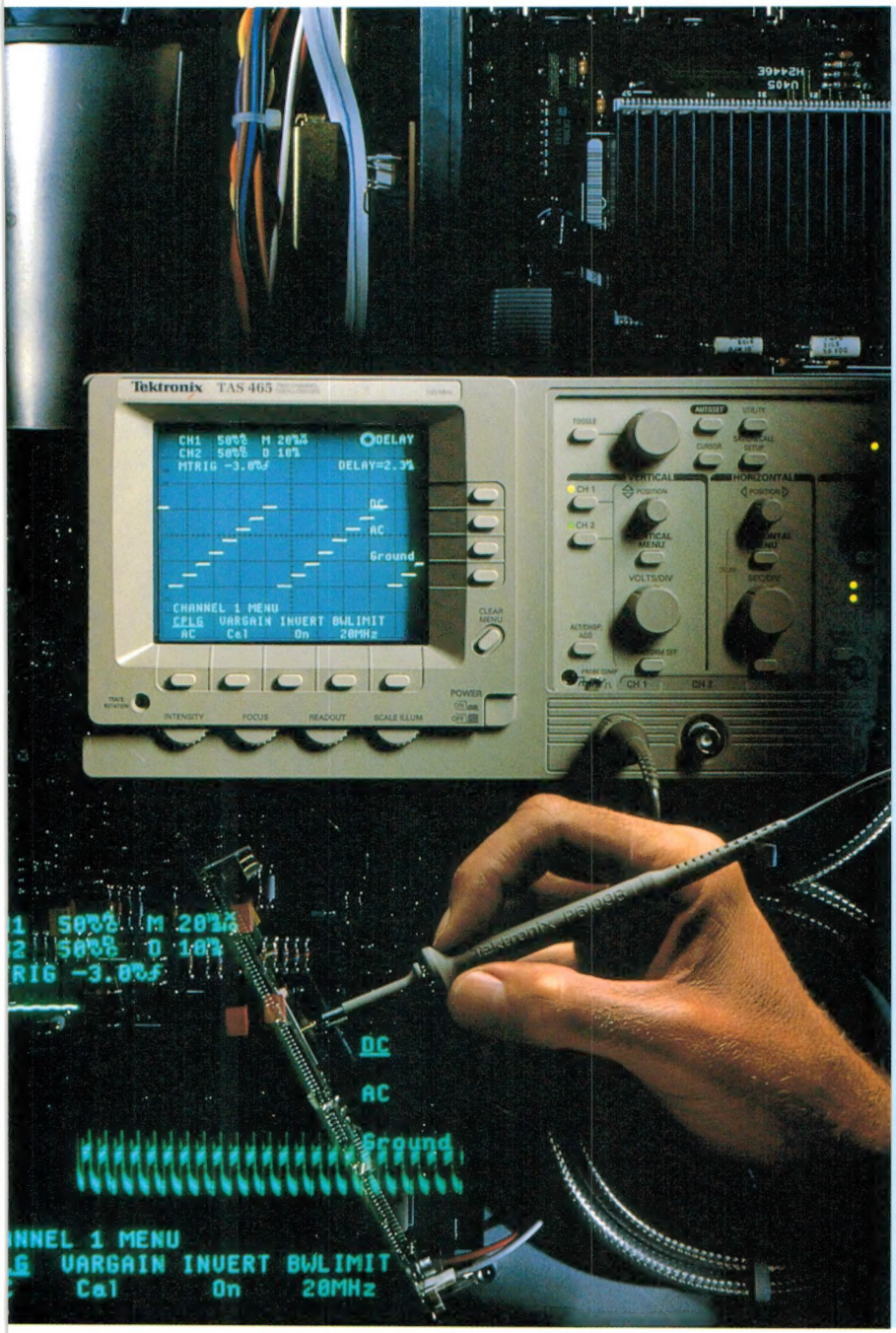

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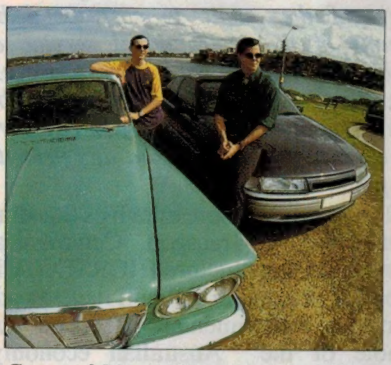
Electronics AUSTRALIA WITH ETI

Volume 55, No.8
August 1993

AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

Mobile hifi enthusiasts



Guy and Monte Wilson are good examples of the growing breed of mobile hifi enthusiasts — people who spend big money in their quest for 'the ultimate' in car sound. Barrie Smith interviewed them (and others) for his story starting on page 12.

Icom's tiny GPS receiver

During the Gulf War, US troops used small satellite navigation receivers to find their way around the desert. Now the same resource is available to all, with handheld GPS receivers like Icom's GP-22. See our review, starting on page 26.

On the cover

Stephen Quigg of the CSIRO's National Measurement Laboratory is shown here measuring the performance of our new soon-to-appear low cost TV-Derived Frequency Reference project, against the laboratory's caesium-clock based National Frequency Standard.

Video and Audio

Features

Projects and Technical

Professional Electronics

Columns and Comments

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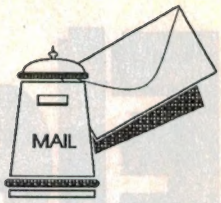
LETTERS TO THE EDITOR



Spectrum Reform

I have great concerns about the Government's proposed changes to the existing Radiocommunications Act, 1983, in order to reform Spectrum Management in this country. My personal and extensive experience in this field has led me to believe that the Government is heading in the wrong direction.

The dynamic and vibrant electronics industry will be the big losers if all of the new changes are implemented. It will be the death knell of what was once an important and world recognised sector of commerce. The Spectrum Management Reform (SMA) will do great harm not only to the communications activity but will ultimately finish off everything connected with the electronics business. Hundreds if not thousands of people associated with the industry will be thrown onto the unemployment scrapheap.

The present Government is ignoring International Regulations governing the control of radio frequencies with the proposed introduction of a 'market system' to replace the current administration system.

The Department of Transport and Communications plan to allocate market spectrum by issuing tradeable, non-prescriptive 'spectrum licences'. Allocation will be by auction, tender or direct sales for a pre-determined or negotiated price, much similar to the plan advocated in the current Broadcasting Spectrum fiasco.

Spectrum licences will be issued for up to 10 years with licensees given the ability to sell or lease out licences at a profit. Frequency bands for radio services are limited natural resources which must be used efficiently and economically and should not be commercialised for the benefit of any interest group. Any such deregulation will inevitably lead to a great part of the spectrum falling into the hands of large multinational organisations or self interest entrepreneurs.

According to the 1982 Nairobi International Telecommunication Convention, Number 22 of Article 4 to the first part of the convention (basic provisions) it states in part: *foster collaboration among its members with a view to the establishment of rates at levels as low as possible consistent with an efficient service and taking into account the necessity for maintaining independent financial administration of telecommunications on a sound basis.*

Number 131 of Article 18 (General provisions relating to Telecommunications) ensure, *members recognise the right of the public to correspond by means of the international service of public correspondence. The services, the charges and the safeguards shall be the same for all users in each category of correspondence without any priority or preference.*

The House of Representatives Standing Committee on Transport, Communications and Infrastructure (HORSCOTCI) report if adopted in full will have an adverse and detrimental effect on the whole of the Australian economy. Many in communications and electronics small business like myself will suffer unduly as a direct consequence. These activities will be controlled by non-Australian multinational companies with huge profits going overseas.

Selling or leasing out chunks to unscrupulous speculators will result in large blocks of the spectrum being bought off, sat on and not being used thereby causing severe congestions in other areas. The existing legislation has proven effective and above all else, it is fair and equitable to all users of radio communications. The revenue from the collection of licence fees presently far exceeds the cost of administration services. According to the Government's Annual Report for the year ending 1991-1992, this amount is in the vicinity of $73,300,000.

Radio spectrum affecting communications in airport operations environments specially at the UHF low band, for example 450.000 to 470.000MHz, must remain unchanged. Re-use of low power UHF land mobile channels in close proximity to international airports must not be allowed.

Localised public communications in such localities are being used for purposes such as passenger and baggage handling, cargo and mail off/onload, aircraft catering and provisioning, refuelling and aeroplane maintenance, runway and taxiway movement control, rescue and fire fighting services, customs and immigration surveillance, tarmac and ramp

apron safety, passenger and aircraft emergency situations, equipment and public security, safety of life in all circumstances, etc.

It is absolutely vital that the operation of all of these activities by using mobile and portable radio equipment are free from any interference. Jeopardising any one of these activities will cause chaos ranging from the mishandling of passengers, disruptions to aircraft ontime performance resulting in extensive delays and in worst case scenarios could even combine with disastrous consequences in the risk of equipment safety, security of property and above all, the well being of precious human lives.

I have been involved in the communications and electronics industry here and overseas for well over 40 years and I have yet to experience such arrogance and total disregard shown by those who are responsible in formulating new policies. The bureaucrats who live in 'glass houses' have no idea of what is going on in the outside world.

They profess to know all, have narrow views and do not wish to listen to advice, suggestions or recommendations. It is sad that the economy of Australia and the future destiny of this country should be guided by the likes of such irresponsible public servants, and ineffective Government members of parliament.

Paris Cockinos,
Managing Director,
Paris Radio Electronics,
Darlinghurst, NSW

New use for solder

By now, most of you with the older mechanical rotary TV tuners will be finding them a little sensitive to touch because of years of use wearing out the contacts inside the tuner.

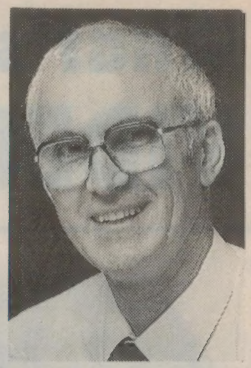
My serviceman said it would cost $80+ to replace the tuner, and I nearly considered replacing the set altogether. An idea came to me. Open the tuner module, and coat the contacts of the rotary dial with a thin layer of solder. Once coated (very slightly, as too much solder will damage the contact), the contacts quickly 'wore in' due to the relative softness of solder, and the contact has fitted snugly every since.

This simple and costless operation has allowed me to put off buying a new set for a few years at least.

Clinton Bird,
Ferndale WA 6148 ❖

DROP US A LINE. If your letter is clearly expressed and on a topic of interest, chances are we'll publish it — but we reserve the right to edit those that are over long or potentially libellous.

EDITORIAL VIEWPOINT



One of the things holding our industry back...

An important sign of a healthy electronics industry, it seems to me, is the ready availability of a wide range of the latest components — for engineers and designers to build into new products, for hobbyists to experiment with and for students to use in gaining hands-on experience. Only when you have this ready access to the latest technology is there the kind of creative activity which results in genuine innovation — and from this comes the products which a country like Australia needs, if it's ever to compete in world markets.

This is one area, I believe, where we still have a real problem. Nowadays, virtually all of our electronic components are imported; and a frustrating number of our so-called components (and equipment) importers/distributors are still essentially 'agency collectors' — firms which seem to secure the exclusive Australian distribution rights to many different brands of attractive products from overseas principals, and then sit back and wait for the customers to beat a path to their door.

Keep stocks? Advertise? Try to actually *sell* the products? Oh no; all of these things cost too much. It's easier to wait until a few persistent people respond to adverts in overseas journals, and contact the principals overseas — who'll refer them back to the local 'distributor', of course. Then they can order a few, and rake off their profit. No doubt if the overseas principal complains about lack of marketing, they can be fobbed off by a few well-chosen words about Australia's tiny manufacturing industry, and its supposed resistance to embrace new technology...

I'm sure that many of *EA*'s readers will easily be able to name half a dozen of these slack 'distributors', from personal experience. For example quite a few readers have written to complain about the difficulty in obtaining the ceramic filters and tuner module used in our recent VHF/UHF Spectrum Analyser project; only one kit supplier was able to obtain these crucial parts — and then only because they imported the parts themselves!

Until now, we've all just shrugged our shoulders, agreed that 'firm X is hopeless', and done the best we could with the components and equipment which *are* properly supported, stocked and distributed. But why *should* we have to 'get by', without access to the excellent components and equipment available from so many overseas suppliers?

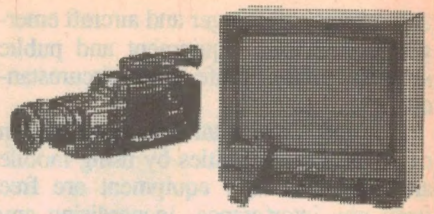
The only way we're ever going to change this situation is by *complaining* — not just to the so-called distributors themselves, but also to the principals overseas whose products we find out about, and want to be able to get.

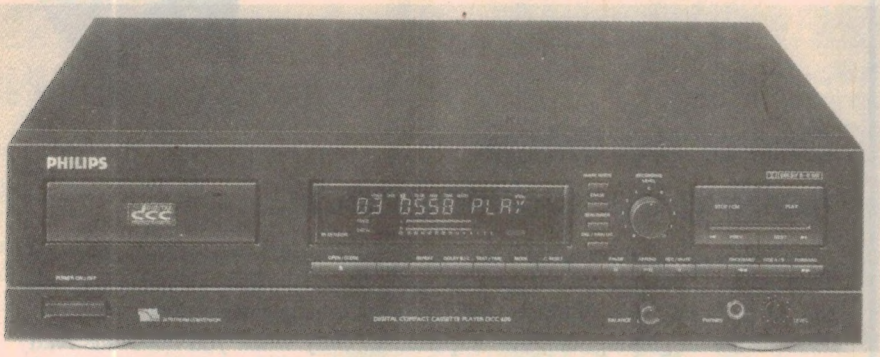
It will probably take a lot of complaining, by a lot of people, before some of these firms finally stir from their slumber. Either that, or other firms with more initiative will realise the potential, and grab their agencies from them.

Come to think of it, perhaps the best way *EA* can help this situation is to turn the spotlight on some of the more outstanding overseas firms, whose products are simply not represented properly out here. How about letting us know which products *you've* had trouble getting, and we'll do just that!

Jim Rowe

What's New in VIDEO and AUDIO





Second model in Philips DCC line

Philips have announced that an additional model Digital Compact Cassette (DCC) player/recorder, the DCC600, is now available in major retail and audio specialist outlets across Australia for immediate retail sales.

"The launch of the DCC600 is a key step in our move to introduce new DCC products into the Australian market in the coming months," said Leigh Robinson, Group General Manager, Philips Consumer Products.

The release of the DCC600 follows the successful launch of Philips' top-of-the-line DCC deck, the DCC900, and the series 900 audio system, plus catalogs of music DCCs by leading recording companies.

The DCC600 is a robust, full-featured hi-fi stereo deck with an RRP of $1499. It has full auto-reverse and, best of all for cassette owners, the DCC600 will play back all existing analog cassettes.

Car speakers from Kenwood

Kenwood Electronics has announced a new car speaker line-up that uses several innovative technologies, including an angled and bridged midrange/tweeter for better top to bottom sound balance and improved imaging.

The new line-up comprises four models in total, which can be purchased either as a Kenwood 'system' or as an 'after-market' speaker.

The two top models (HQ162 and HQ132) use a special construction that 'bridges' the midrange and tweeter units across the top of the woofer, allowing a woofer cap to be fitted for a solid upper-midrange sound imaging.

This additional rigidity doesn't allow the woofer's middle and high range tones to influence midrange and treble tones of the mid and treble drivers. The result is claimed to be an extremely accurate vocal range with highly detailed and clear highs.

Camcorder has remote monitor

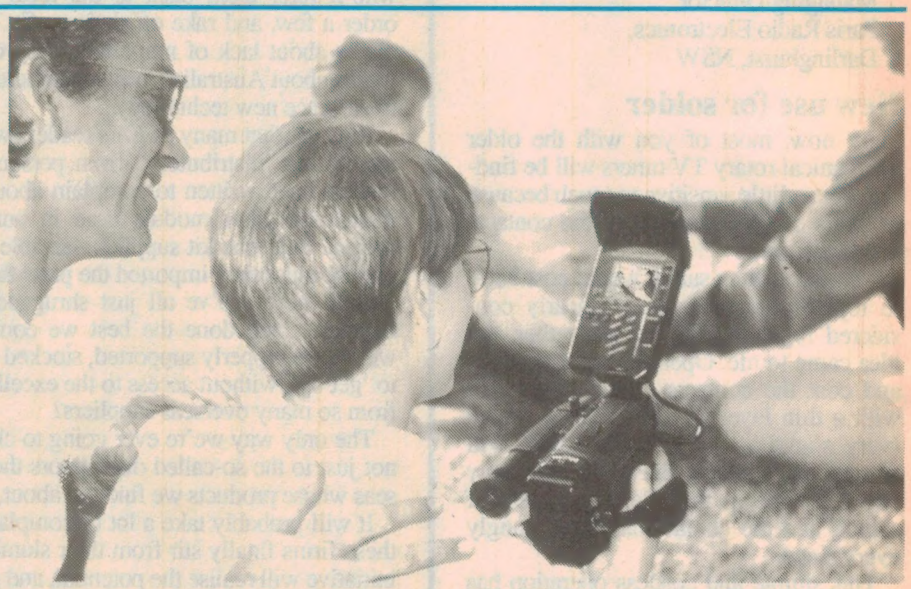
If you have ever wanted to show your video as soon as you have taken it, or tried taking large group shots by remote control, then you'll appreciate Sanyo's remarkable new VM-EX30P camcorder, which comes with a colour monitor remote controller.

Claimed to be the first ever unit with a remote colour LCD screen, this new style of remote controller enhances performance in shooting, viewing and editing, and can be used either free-standing or mounted on the camcorder.

With a conventional viewfinder, it is necessary to shoot with one eye close to the eyecup. Peering at a tiny black and white viewfinder image takes the fun out of shooting and can cause fatigue.

The new colour monitor remote control allows you to shoot without this restriction and with much more freedom. It makes life easier for those who wear glasses and for those who might be forced to use their weaker eye with conventional viewfinders.

With a conventional remote controller, there is no way of knowing if everyone is included. Now the whole family, even the camcorder operator, can be included in the picture. By using the colour monitor remote controller with the supplied extension cord, recording can be easily checked on the monitor screen by all the subjects.



Recordings can be played back instantly and everyone can enjoy them, in colour and on the spot, without the hassles of connecting to a conventional TV set.

Other features of the VM-EX30P include fully automatic 'triple fuzzy logic' for auto focus, auto exposure (iris control) and auto white balance.

Sanyo's VM-EX30P is now available at a recommended retail price of $1999.00.

Kenwood has also offset the mid/tweeter units in the HQ models by five degrees, to allow the full output to reach the listener more directly for better top to bottom sound balance.

The HQ units also employ a proprietary pure butyl-rubber edge suspension on the woofer instead of the conventional urethane. The butyl-rubber suspension offers much greater internal loss and accentuates edge reflection that can cause audible distortion.

The new car speaker line-up comprises:

KFC-HQ163: a three way, three speaker system with bridge construction 6.25" polypropylene woofer, 2" midrange, 13/16" dome tweeter, power handling 150W, peak frequency response 35Hz - 30kHz, designed for door/rear door installations.

KFC-HQ132: A two way, two speaker design with bridge construction 5" polypropylene woofer/mid, 1.25" polymide dome/tweeter, power handling 80W peak, frequency response 45Hz - 30kHz, designed for door/rear door installation.

KFC-HQ102: A two way, two speaker system using a 4" polypropylene woofer, 1" polymide balanced dome tweeter with Ferro-fluid cooled gap. Power handling 60W peak, frequency response 55Hz - 22kHz, designed for door installations.

KFC-7180: A three way, three speaker system custom designed to fit 6 x 9" cutouts. Comprises 7 x 10" injected moulded polypropylene woofer, 2.75" water resistant cone midrange and 1" dome tweeter. Power handling 240W peak, frequency response 26Hz - 26kHz.

The new Kenwood HQ Series and KFC-7180 Car Speaker Systems are available at all leading Kenwood car audio dealers.

Panasonic VCRs have 'Super Drive'

The latest additions to Panasonic's range of VCRs feature a new Super Drive system to speed up access to all functions.

The Super Drive system features an advanced, full-time, full-loading device to deliver precise, high-speed operation, while protecting tape and heads from damage.

A new DD capstan motor also enables high speed search and minimises fluctuations in capstan rotational speed. The mode switching motor even speeds up playback functions such as fast forward and rewind.

Model NV-SD10A VCR is equipped with a new shuttle ring which controls fast forward and rewind as well as variable speed searching. Likewise cue and review can be controlled by the shuttle to allow the operator to check a scene easily at any given point.

This model, which features three video heads, boasts outstanding image clarity in every mode. Even slow motion and still images come through totally noise-free.

The NV-SD20A four head model features super jog and shuttle. It offers all the convenience of the shuttle ring plus the added control of being able to cue or review frame by frame.

This model also facilitates NTSC playback on a PAL TV, without additional connections.

The NV-SD10A is priced at an affordable $649 recommended retail, while the feature packed NV-SD20A is only $799 recommended retail.

New affordable speakers from Jamo

When Jamo's long awaited flagship, the Oriel, was released last year, it attracted the attention of hifi reviewers, specialist hifi dealers and audio enthusiasts. But with a price tag of $17,000 per pair, not many enthusiasts are likely to end up with these loudspeakers in their home.

Jamo is now releasing a new range of affordable loudspeakers which clearly bear resemblance to the Oriels as they are a direct result of the know-how gained during its development.

The new 7-series consists of two bookshelf models and two floorstanding models. The two floorstanding models, the 507 and 707, share many design features of the Oriels. The first thing that is obvious is the curved sides of the cabinet. This new cabinet design has an obvious advantage of eliminating internal standing waves and gives the speaker great strength due to the sandwich-constructed side panels.

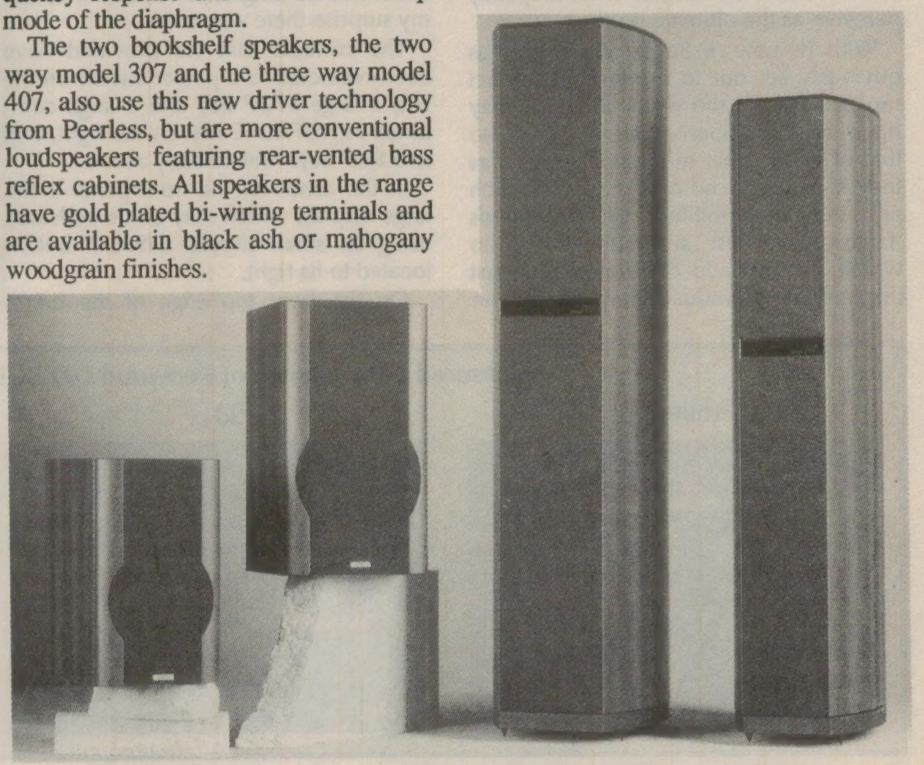
Both models feature internally mounted dual subwoofers operating in bandpass, push-pull configuration with a large 100mm port in the rear of the cabinet. On the front of the speakers two 4" or 5" bass/midrange drivers are positioned with a 25mm soft textile dome tweeter in between. This point source configuration results in a controlled vertical dispersion which makes the speaker less room dependent and easier to position in a normal living room.

The new bass/midrange drivers, which are manufactured by Peerless in Denmark, are using a new patent where the rubber suspension is vulcanised to the injection moulded polypropylene diaphragm. The result is a more linear frequency response and a more break-up mode of the diaphragm.

The two bookshelf speakers, the two way model 307 and the three way model 407, also use this new driver technology from Peerless, but are more conventional loudspeakers featuring rear-vented bass reflex cabinets. All speakers in the range have gold plated bi-wiring terminals and are available in black ash or mahogany woodgrain finishes.

Prices are between $800 and $2800 per pair and will be available through selected hifi specialists around the country.

For further information contact the sole Australian distribution: Scan Audio Pty Ltd, 52 Crown Street, Richmond 3121; phone (03) 429 2199, fax (03) 429 9309. ❖



KENWOOD'S NEW L-D1 CD PLAYER

This month Louis Challis ran his instruments over the latest addition to Kenwood's hifi component range: their new 'top of the line' L-D1 compact disc player (one of which is part of our current subscription promotion prize). Its performance turned out to be pretty staggering — even Louis seems to have been impressed!

With the majority of manufacturers of hifi equipment vying for increased sales through lower cost of production, and through increased usage of large scale integrated circuits or 'LSI chips', it's intriguing to find that some firms, like Kenwood, have decided to develop a range of esoteric hifi components — each one of which individually costs more than most people are prepared to spend on their whole system.

Of course that concept is not really new. Sooner or later most manufacturers feel that they need to make a statement, and that statement is often made by having a 'top-of-the-line' product range, which are designed for those who are able to afford the best, or what they may perceive as the ultimate product.

With its new 'L Series' Kenwood has obviously set out to produce a product range in which the word 'ultimate' may have slightly different connotations to that of many other hifi manufacturers, as they have produced new products which are truly exemplified by the words 'largest', 'heaviest' and 'strongest' — to which I would add the words 'amongst the very best products that money can buy'. As a case in point, the new L-D1 CD player and matching L-A1 top of the line amplifier are most certainly the heaviest, and it would appear the most costly items of their type that I have as yet been asked to review.

When I picked up the L-D1 CD player in order to place it on the test bench, I immediately discovered just how heavy this CD player really is: a massive 20kg.

The next thing to catch my attention was the top of the player, which incorporates an unusual top-hinged lid. As I glanced at the front panel of the CD player, I was surprised to note how few switches or controls have been provided. I looked twice to convince myself that there was no hinged panel, and much to my surprise there was none.

The controls that are provided have been restricted to a power switch on the left, a large STOP key and a large combined PLAY/PAUSE key on the right, and two SKIP keys immediately above.

In the centre of the front panel is the large display, which may be de-activated using the small circular DISPLAY button located to its right.

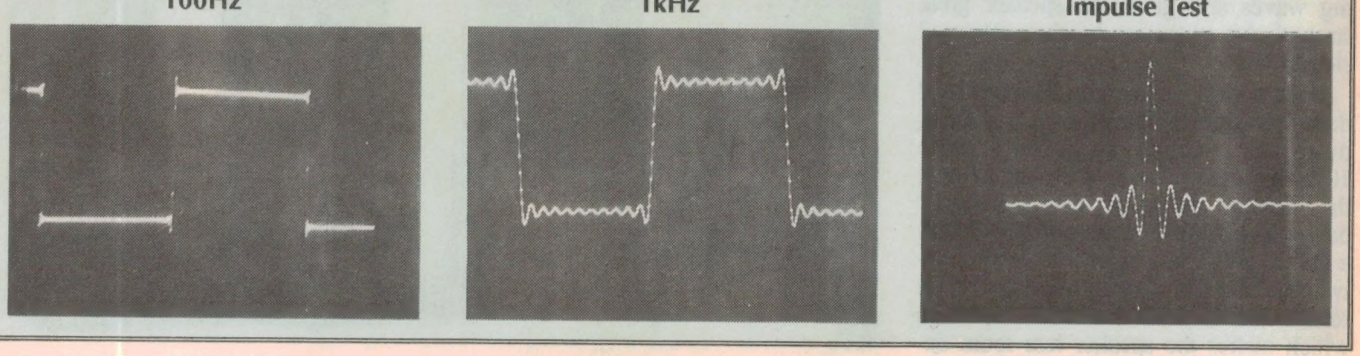
On the front top edge of the bright anodised aluminium cabinet is an OPEN/CLOSE button, which activates the hinged CD tray lid located at the front centre of that cabinet. The extent to which the hinged lid opens is switch selectable for three different angles of 45°, 60° and 80°.

The angles can be selected by means of a switch on the rear panel of the player. The reason for providing three different angles is, as I subsequently discovered, a very pragmatic one. It's to accommodate possible variations of shelf clearance, directly above the player — which may be as low as 100mm with a 45° angle, or as much as 160mm with the 80° opening angle selected.

With the lid open, the heavy CD turntable and its 100-gram supplementary dampener weight are in full view. It is only then, when you pick up the removable dampener weight, that you realise that Kenwood has chosen a 'reverse' system where the CD has to be inserted upside-down, with the label underneath — so that the active face of the CD is facing up.

Whilst not unique, the concept is initially disconcerting for somebody like me

Measured performance of Kenwood L-D1 CD player



who has used over a period of 10 years a series of 'conventional' CD players, all of which take the disc with its label 'uppermost'.

'Maximum inertia'

Kenwood claims its reason for adopting this approach was to ensure that the turntable has maximum possible inertia, and as a consequence optimum speed stability.

This may be true, but as I understood it, the CD's digital data should be relatively independent of the speed stability of the player. There is neither measurable nor detectable 'wow' or 'flutter', where the digital data is being converted into acoustical data at a clock speed which is itself independent of any potential speed variation in the player or its turntable.

Kenwood has incorporated a turntable drive which is also markedly superior to more conventional types: it has adopted an eight-pole, 12 slot outer rotor brushless motor, which I have no doubt is among the very best that money can buy.

With a turntable that has 20 times the inertia of most of its competitors, and a servo-tracking system which is equally advanced, it is not surprising that Kenwood can claim with some justification that the L-D1 has a speed stability which is 'infinitely better' than most of its competitors. Whether or not that speed stability leads to improvements in audible performance is a somewhat different question...

In order to operate the player and derive all of its normal functions, and specifically those for which control switches are not provided on the front panel, Kenwood provides a remote control unit (the RC-D1) which is neat and effective. However it offers no special or otherwise new or natty functions that the majority of its competitors don't already provide.

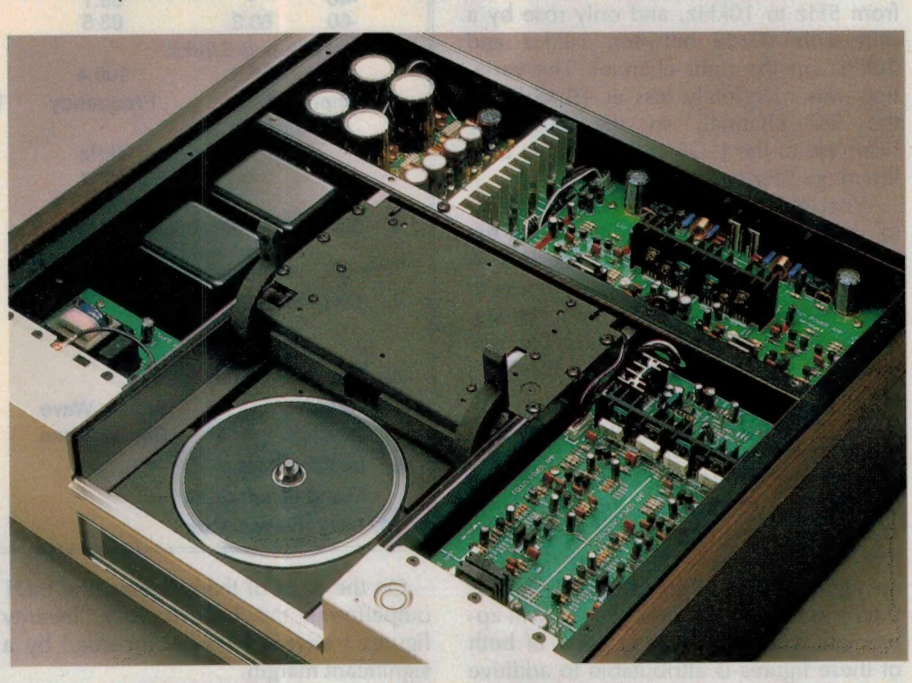
The rear panel of the CD player provides two pairs of line outputs, instead of the normal one, and a digital coaxial as well as an optical output, together with the three-position door angle switch.

Massive construction

On opening the bottom of the cabinet of the CD player, you quickly realise just how massive the internal steel chassis is — and immediately form the view that extremely thick aluminium extruded components incorporate metal gauges and thicknesses which would gladden the hearts of almost any steel works or aluminium producer.

On examining the works more closely, I discovered that the laser pickup straddles the disc, with a 'roll out' system that is activated once you close the lid. The laser pickup system adopts the same design philosophy as the turntable, as it too has been designed to minimise vibration. It also uses a nifty and effective servo control system, which avoids the problems that I have recently experienced with my own CD player as a result of bumping (and damaging) the roll-out CD drawer.

The L-D1 uses a one-bit pulse density demodulator system, before conversion to an analog signal in its D to A converter. The components for this system have been very carefully selected and even



Inside the player. The 'rollover' laser pick-up is hidden under the metal plate just behind the heavy turntable. The construction throughout is massive, producing an all up weight of 20kg.

more carefully individually matched, to achieve extremely good linearity and signal-to-noise ratio figures.

Although the circuitry and the layout of the electronics may be viewed as being 'almost over the top', there is no denying that the choice of components, the adoption of independent power supplies for the digital and analog sections, and the adoption of Kenwood's proprietary Constant Current Cascade Circuit unquestionably reduces unwanted noise in the audio output section of the L-D1.

The addition of all these extra components, and the sheer thickness of internal and external panels and internal divider elements, results in an absolutely massive, and 'tank like' construction.

When you view this CD player with some of its panels removed, you then comprehend why the L-D1 is so heavy. You also begin to appreciate just how much care and trouble Kenwood has taken to minimise unnecessary problems and/or future anguish, for an owner who has purchased this player in order to achieve the very best that money can buy.

Objective testing

The objective testing of the L-D1 was a most pleasant task, for as I soon discovered just about every parameter that I set out to measure proved to be either the best that I have yet measured — or if not the best, certainly equal to it.

The frequency response was ruler flat from 5Hz to 10kHz, and only rose by a minuscule 0.2dB between 10kHz and 20kHz on the right channel. The variation was marginally less at +0.15dB on the left channel, so the frequency response of the L-D1 is impeccable over the range 5Hz to 20kHz.

What pleased me more was the digital to analog transfer linearity, over the dynamic range capabilities of the D to A converter. There was absolutely no trace of conversion non-linearity until the signal dropped to -80dB, where the discrepancy is a minuscule 0.1dB. As I realised, a significant portion of that 0.1dB could be attributable to noise, rather than non-linearity as such.

I had to drop the test signals to -90dB before I could measure any significant conversion non-linearity, and at that level the indicated non-linearity was 0.9dB in the right channel, and marginally less at 0.6dB in the left channel. As you will appreciate a significant proportion of both of these figures is attributable to additive random noise components, which at these low levels cannot be readily suppressed by my measurement system.

Measured performance of Kenwood L-D1 CD player
Serial No. 30300131

1. Frequency Response

20Hz to 20kHz +/- 0.2dB
5Hz to 22.05kHz +/- 0.1dB

2. Linearity

Nominal Level	Left Output	Right Output
0dB	0.0	0.0
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-20.0
-30.0	-30.0	-30.0
-40.0	-40.0	-40.0
-50.0	-50.0	-50.0
-60.0	-60.0	-60.0
-70.0	-70.0	-70.0
-80.0	-80.1	-80.1
-90.0	-89.4	-89.1

3. Channel Separation

Frequency	Right into Left dB	Left into Right dB
100Hz	93.3	98.7
1kHz	100.0	101.9
10kHz	98.4	98.9
20kHz	91.1	92.8

4. Distortion @ 1kHz

Level	2nd	3rd	4th	5th	THD%
0	105.5	109.8	112.0	112.6	0.0003
-1.0	105.1	106.6	117.8	116.0	0.0003
-3.0	-	104.4	-	-	0.00032
-6.0	-	-	104.4	106.6	0.00044
-10	104.6	-	-	-	0.00022
-20	-	-	-	-	Below Noise
-30	92.0	86.9	-	-	0.00252
-40	-	-	-	-	Below Noise
-50	-	66.6	73.8	67.0	0.042
-60	49.4	51.8	-	57.0	0.204
-70	-	39.4	-	39.4	0.95
-80	-	26.1	-	27.3	4.0
-90	-	27.4	-	13.4	22%
Distortion @ 100Hz					
0	103.8	113.4	120.1	103.7	0.009
-20	102.8	100.4	105.5	96.4	0.002
-40	-	88.1	83.1	87.2	0.009
-60	60.2	63.5	63.3	62.9	0.15
Distortion @ 6.3kHz					
0	96.6	100.4	-	-	0.0015

5. Emphasis

Frequency	Recorded Level	Output Level (L)	Output Level (R)
1kHz	0.37dB	-0.4	-0.3
5kHz	-4.53dB	-4.6	-4.5
16kHz	-90dB	-9.0	-9.0

6. Signal to Noise Ratio

Without emphasis 105.2dB (A)
With emphasis 105.3dB (A)

7. Frequency Accuracy

Test signal 19.999kHz
Measured 20.000kHz = +/-1Hz (+0.005%)

8. Square Wave Response

	Result
100Hz Square Wave	Excellent
1kHz Square Wave	Excellent

9. Impulse Test

See attached photo — Excellent

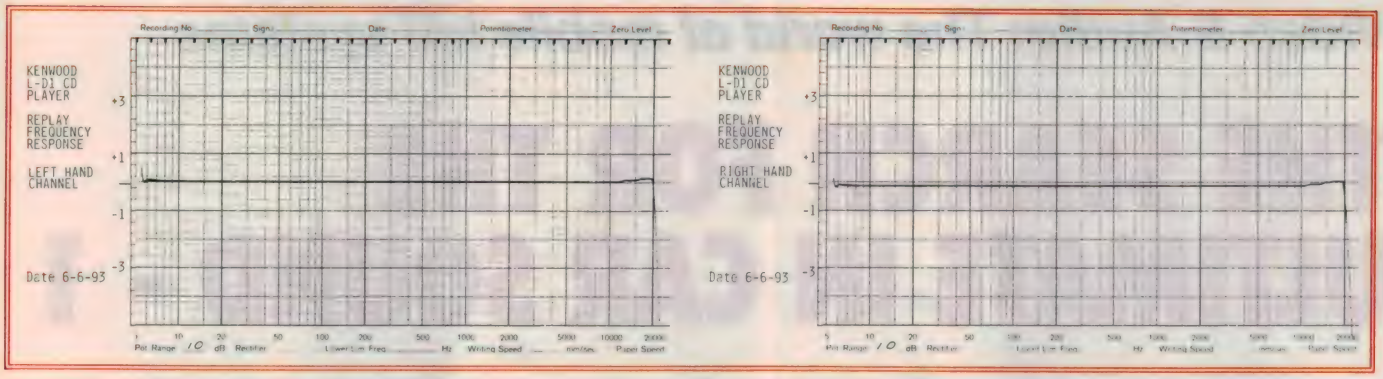
10. Dirty Record tests

Pass all levels including 2500 micron.

On the basis of these figures, the L-D1 outperforms the best transfer linearity figures I have previously recorded by a significant margin.

The channel separation figures are as good as you could really ask for, being better than 91dB at all frequencies tested. This indicates that considerable care has been taken to provide the appropriate degree of separation in the analog circuitry, which is where the problems of channel separation and cross-talk normally occur.

The distortion figures are also remarkably good, with distortions as low



As you can see from these plots, the frequency response of the player is almost perfectly flat from 5Hz to 10kHz, and even then it only deviates by a tiny 0.2dB between 10kHz and 20kHz. The linearity also turned out to be exceptional.

as 0.0003% at 0dB, and which are still under 1% at -70dB. At -80dB the distortion rises to 4%, whilst at -90dB, the distortion rises as must be expected to a figure, which although relatively high at 21%, would not be audible as such.

Although most of the other figures like the speed accuracy, square-wave tests, and the impulse tests were faultless, the objective test that really caught my attention, were those associated with the frequently forgotten 'Dirty Fingerprint Tests', 'Interruption in the Information Layer', 'Black Dot Tests' at the readout side, and the 'Black Stripe Test'.

This group of tests were developed by Philips back in the early 1980's, to assess the tracking ability and capabilities of the digital circuitry to restore information which has been destroyed by inadvertent abuse of the CD that you happen to be playing.

As I discovered later, the original Philips test disc, although appropriate for the first generation of CD players, does not incorporate adequate information for the latest generation of CD players — which are markedly superior compared with the first and second generation players. In order to redress the problem, with the help of Distronics, we arranged for a special test disc to be manufactured with an outside black stripe which covers the range from 1000 to 2500 microns.

No CD player that I have tested before has ever been able to track beyond 1500 microns without introducing disturbing 'clicks' and 'pops' as a result of the fault removing information which the error correction circuitry could not replace. But to my surprise, the L-D1 tracked all the way up to 2500 microns (2.5mm) — at which point it was just starting to intermittently display the onset of clicking.

This is no mean feat, and to confirm what I had found, I played a special 'abused' disc, whose primary surface had been deliberately damaged by scratching it underfoot on a rough concrete floor. I wasn't really surprised to find that the L-D1 tracked the damaged disc as though the scratches were simply not there, and the signal output showed no traces of audible clicking or distortion.

Listening tests

Having confirmed that the Kenwood L-D1 CD player displays an objective test performance which is nigh-on perfect, and notwithstanding my minor criticism of the rationale underlying some of Kenwood's marketing claims, I progressed to the subjective evaluation of the L-D1.

For the subjective evaluation, I connected the L-D1 to the matching Kenwood L-A1 Integrated Amplifier, which was designed to complement the CD player, and which weighs in at a hefty 27.6kg. The L-A1 provides continuous output powers of 120 watts per channel into eight ohms, and peak powers that are close to twice that value. The output of the amplifier was then fed directly to a pair of B&W 801/M monitor speakers, which I set up in my monitoring room.

For the subjective calibration I used a series of new discs, including 'Midori Encore' — featuring Midori on violin and Robert McDonald accompanying on the piano, with an exquisite selection of pieces by Kreisler, Paganini, Faure, Tchaikovsky and Sarasate and others (Sony Classical SKJ52568).

I have been impressed by Midori's playing since I first heard her early recordings some two-and-a-half years ago, when Sony Classical released her first disc. Whilst I was impressed, I felt she lacked experience and that her stark technique required further development which time and experience to other world class musicians would in the course of time provide. In those short two-and-a-half years it's now readily apparent that Midori has gained considerable experience, and the quality of her playing has lost most of the features which were potentially disturbing.

The sensitivity of her playing on this new disc was exciting. The music was realistic and as close to a live performance as one could desire, and the L-D1 and the L-A1 produced a feeling of elation which is hard to describe.

I progressed to another violin disc featuring the Juilliard String Quartet in Verdi's String Quartet in E Minor, and Sibelius' String Quartet in D Minor (Sony Classical SK 48193). Whilst Verdi's Quartet in E Minor was a trifle heavy, the Sibelius 'Voces Intimae', was brilliantly played and showed just how well the music could sound when played through a system in which each individual item of equipment was as close to perfection as one could desire.

I played numerous other discs, including Sade 'Love Deluxe' (Epic 472626 2), about which I will have much more to say in a future review, and discovered why 'No Ordinary Love' and the other pieces on this disc have put Sade at the top of the charts in the UK.

Summary

The Kenwood L-D1 CD player is an exceptional piece of equipment, which is being marketed with what I consider a rather daunting price.

As good as it may be, its physical dimensions are equally daunting, as there are relatively few equipment set-ups or positions in a conventional living room where a piece of equipment as large and as heavy as this can be conveniently located.

But apart from the physical dimensions, this CD player is the best that I have tested, and may well be the best that you can buy.

The actual dimensions of the L-D1 compact disc player are 476 x 128 x 430mm (W x H x D), and as noted earlier it weighs 20kg. The recommended retail price is $4199. It will be available from selected Kenwood dealers, but further information is available from Kenwood Electronics Australia, on (008) 251 697. ❖

THE SEARCH FOR THE ULTIMATE IN CAR SOUND - 1

As you putter along in the Kingswood, does your mind ever drift to dreams of a mobile stereo system with 10 or more speakers, powered by 1000-watt amps delivering 20Hz-20kHz within 1dB? You may not be aware of it, but for many mobile sound enthusiasts this is not just a dream — it's a reality!

by BARRIE SMITH

This whole incredible story of an industry noisily — yet imperceptibly — rocking around our streets began with a call to *EA*'s Editor from Bruce Wilson, of Brookvale in Sydney. Once active in the audio and vision areas of broadcast TV, Bruce has two sons — Monte and Guy — who live, breathe, fiddle, hum, strum and burn their ears constantly with their own high-end car sound installations.

The Wilsons thought there might be a story for *EA* readers in the whole business, and there certainly was. I spent a decibel-laden few hours with them and their two cars, to dig out the whys, hows and wherefores of high quality car stereo. This in turn led to visiting some of the dealers, and so it developed.

Doing it *their* way

Firstly, let's clear out a few misconceptions. Called by many names — car stereo, in-car entertainment, car hifi, sound installations and so on — the process of packing an automobile with a few thousand dollars' worth of high quality audio equipment does not begin and end with a visit to your local car radio shop, nor even a major electronics retailer.

A high quality sound installation grows in a somewhat organic fashion, and begins with the purchase and installation of a suitable 'head unit' — a radio tuner/cassette — plus a speaker or two.

As the car owner's ears become educated and they acquire increasing knowledge of the possibilities and potential of a customised unit, the fun ensues and the system expands. Either by the owner himself doing all the leg work and labour, or by him heading for one of the specialist car installation companies.

The 1979 Pontiac Firebird 79 owned by Powersound, customised five years ago. The car's value is $20 - $30,000 — but it's packed with $16,500 worth of audio.

Monte Wilson is a sales rep, spending nearly all his day in the car. He felt an installation was a worthwhile investment. His first setup was all Sony gear — a CD player, a control unit, plus multi-way speakers in the front and back.

Says Monte: "It sounded quite OK. The bass was just so much better than any I'd heard in any car before. This was in an XE Fairmont. Then I felt inclined to get some more bass, so I got a 15-inch subwoofer, set in a bin box in the boot. That was run off a 120 watt RMS amplifier; the cutoff was 80Hz."

The investment involved? Monte's current auto is a Calais — valued at $25,000, with hifi system worth about $2500. The head unit and CD deck came from the Fairmont. He added, "I have a pair of 4" two-way speakers in the front and a 5" mid range and 1" tweeter in the parcel shelf, while the original 15" subwoofer was replaced by two 10" subs on the back shelf".

Upwards expandability is the name of the game in car stereo. In terms of power, Monte's Calais system provides a total of 540 watts peak, or more accurately 120W RMS for the subwoofer and probably 100W RMS for the remaining speakers.

But was the whole quest a search for sheer wattage?

Monte: "No, definitely not. It's for clarity, in my case. My brother Guy's quest has always been for wattage, but clarity is something I really enjoy. A bit

The head unit in the Pontiac is an Alpine three-disc CD player with radio tuner.

The Mazda's Alpine 7618E head unit. An Alpine 5957S six stack shuttle CD player is placed under the seat, along with a cassette player.

of bass is always worthwhile spending a bit of money on, but be warned: it does get very expensive for big amplifiers."

Range of music?

What kind of music does Monte play in his car? "The full range, from Bach organ music right through all the classics. I've got a lapse in the jazz period. But then I've enjoyed some of the well-known rock bands of the 70's, and into some of the really heavy dance music for which the subwoofers are basically designed for. It seems to me that subwoofers are so much more popular in cars than in lounge rooms — with units that cut off at 75 or 50Hz — and really give heaps of power."

Is electrical interference a problem? "Engine noise has been a problem with mine. I've had earth loops and things, some of which I have yet to hunt out — it's probably by virtue of the control unit being earthed onto the chassis. I really should run a floating earth."

And road noise? "People said to me initially, 'don't buy a CD player for your car, because you'll never be able to appreciate it', but the moment I turned it on it was 100 times better. You just couldn't believe the difference, it was undeniable."

Valiant volume

Monte's brother Guy Wilson kicked off with an old S series T62 model Valiant, which he still owns — fitting an old deck and a 10-disc CD stacker.

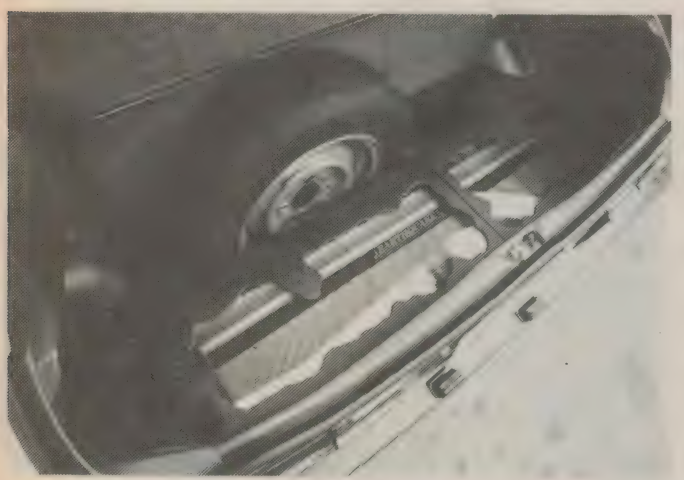
Guy: "From there I added two separate amplifiers for the subwoofers, plus two 15" Jensens and two three-way 6x9's and two 6" three-ways for the front. The 15" Jensens didn't give the ratings they claimed — 300 watts peak — and couldn't handle the wattage I was giving them, which was almost 120W per speaker. My enclosures were probably too small."

Guy's current setup is more elaborate: "In the rear are two sixes which run at full range. In parallel are two one-inch tweeters, run by two amps — peak claimed 200W — going to each speaker pair. In the subwoofer I've got two hefty 15" cast Earthquakes — the magnet weighs about 113 ounces — powered by 120W RMS amps going to each of them, set into specification boxes of 1" MDF board — 6000 cubic inches, with specification three-inch diameter ports, seven inches long."

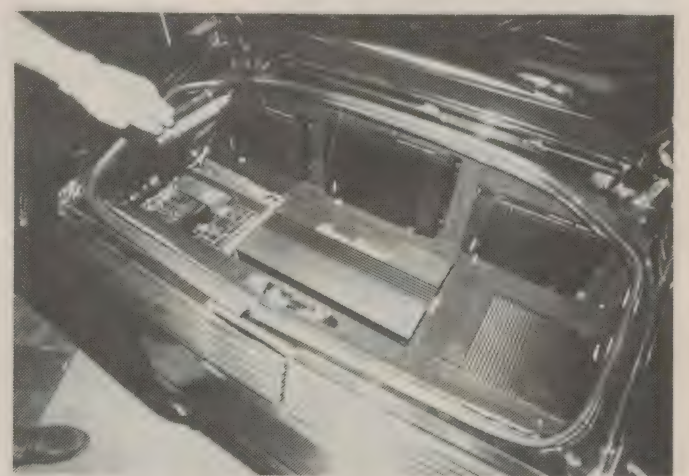
The investment in this system? "Bordering on $2500. The car's worth $3000. If I knew at the very beginning all the way ahead, I would have saved a lot of money."

Advises Monte: "If you're going to get serious with car stereos, go and talk with people who've done it — see what they've spent and what they've got. Then decide whether it's worth the money, and buy the right equipment initially."

Did Guy's 30 year old Chrysler present road noise problems?



Inside the boot of a Turbo 323 Mazda, owned by one of Powersound's staff. The car's value is $15,000; the value of its audio gear is $8000 plus a further $2000 for installation.



In the Pontiac's boot is a parametric equaliser, under a lift-up flap. Crossovers are mounted underneath. Every speaker pair is dedicated to an amplifier — six in all.

Search for the ultimate in car sound - 1

Guy: "You generally don't hear the road noise. Some people do go as far as changing the interior insulation — head lining, etc., — in an older car. I've just been fixing a lot of rattles, recently. You always find problems with boots. They tend to rattle a lot. And straps on fuel tanks, number plates, badges, etc."

Rattles, Guy explained, disappear in inverse proportion to the in-cabin audio level. Obviously, when you run the system at 'ear-bleeding' volume, other noises tend to disappear!

Humungous hifi

Slap in the middle of Parramatta's 'Auto Alley', I found Graham Humphries' Powersound car installer business. In the business for over 23 years, Graham has seen the trends come and go.

Still fondly remembered is the eight-track cartridge player, with its endless loop of tracks that seemingly could run forever. Tammy Wynette all the way to Wagga!

Explained Graham: "Unfortunately eight-track died the death because you couldn't get software. That's where it gets down to, but it was a lovely medium."

"I actually started in this industry when we were fitting Philips record players to cars. A little 45rpm job — snap the centre out of it, slide it in."

What about AM stereo?

"Dead. Greatest marketing device that ever came out, and the greatest flop, I think. One example: Pioneer were the first to bring out an AM stereo in the Australian market, and first to drop it. I've got 130 different models in stock — only two of them have got AM stereo."

DECIBELS AT THE READY

Parammatta installer Graham Humphries is right behind the Sound Off contest — for reasons not entirely altruistic. Originally out of America, Alpine instigated the contest in Australia, and with the help of a few dealers, managed to get state branches up and running.

Humphries: "It's purely aimed at the amateur, the consumer. We run four power classes: 0-100W, 101-250W, 251-500W — and a 501W-plus class. Additionally, a Pro class has been included — specifically for industry personnel."

The aims? To promote mobile audio, to help people improve their setups. With a slice of raw cheek, Humphries adds "In a naive way, it's to get the guys to spend all their money on audio, before the paint job and the mag wheels."

Judging takes into account two areas: sound and quality of installation. For the first, a microphone is fixed inside each car, monitoring a series of tape- or CD-reproduced test tracks — pink and white noise, etc. The mike's output is fed to a Real Time Analyser which appraises frequency response, sound pressure levels, staging, stereo imaging, sound linearity at low and high volume, frequency separation and clarity between sub bass, mid bass, mid and highs — as well as absence of noise through the system.

I asked Humphries about the sound pressure level scoring. His reply: "Basically, a maximum of 26 points is possible — allocated from 100dB and above. You score 26 points when the level reaches 126dB."

Isn't that the threshold of pain, I queried?

"Yeah — and no. The SPL is done with nobody in the car. The judge just cranks it up with the microphone in the car."

"Volume is in the hands of the clown who's got hold of the knob, when you think about it. OK — some people do crank it up, but what we're trying to do is build good quality sound."

Having adjudged the technical areas, the contest then moves to the installation itself: such niceties as wiring cosmetics, intended use of vehicle, componentry installation and integrity, cosmetic integration, ergonomics, attention to detail and general creativity all play their part in the competition.

We sat in the front of his showroom, battling to talk over the heavy traffic. At my elbow was a $20-30,000 T79 Pontiac Firebird, customised five years ago, packed to the sunvisors with $16,500 worth of audio.

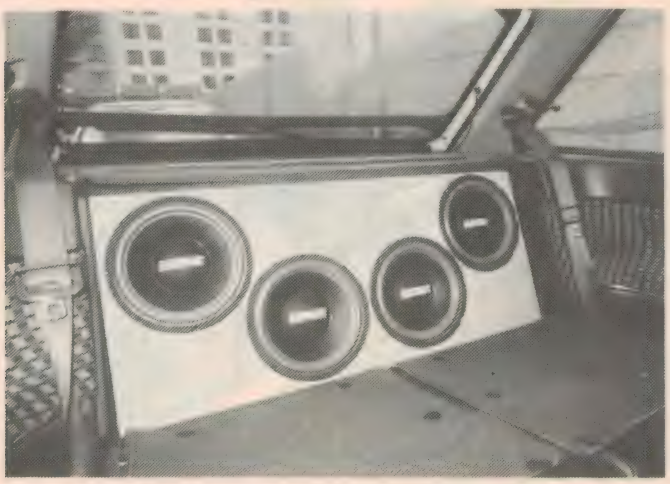
Graham admitted it was brilliant in its time, but 'competition-wise' not as good as it could be on today's standards.

Competition, I asked? He described the Sound Off series. (see the sidebar 'Decibels at the Ready'.)

At the back of Graham's shop was a tiny Suzuki Swift, bought as an ex-demo for $15,500 and intended as a display car.

Said Graham: "Originally, it had $17,500 worth of gear on it. We've just gutted it to rebuild a system worth effectively $6000, plus installation."

"We've done some really humungous stuff — cars with up to $20,000 worth of equipment in them. Then we did a simple system — with a small amount of componentry in a Celica — but $4000 worth of labour and custom door trims



In place of a whopping great bin enclosure, the Mazda's subwoofer box has been built under the floor, so its output goes down the back and under the back seat.

The amps in Monte Wilson's Calais deliver a total power of 540W peak, or more accurately '120W RMS for the subwoofers and probably 100W RMS for the remaining speakers'.

Avid car sound enthusiasts Guy and Monte Wilson, with their cars.

— all one-off stuff. The guys out the back have got to be craftsmen, able to work with timber, fibreglass, cloth trimming and so on."

Car stereo seems to invade the very mentality of some enthusiasts. A classic example was one of Powersound's 'regular customers' who, over a year, bought just on $9000 worth of stereo equipment.

"As his pocket allowed, he took each article home and put it under his bed. Then, when all the system was put together, he got this big 15-inch driver and went around car yards working out which car he had to buy to fit the stuff into. I mean, there's a guy who's *really* thinking about his sound, you know!"

Another was a simpler installation in an HSV ute. By overstating the obvious, Graham explained "You don't have room to fit subwoofers in. So we built a subwoofer enclosure in the back of the ute's cabin — two 12-inch woofers firing into a sealed enclosure, firing into another sealed enclosure at the back of the ute and then ported from there between the seats and into the cabin. Absolutely enormous, awesome."

Any problems?

When I enquired if they had any common problems, Graham answered "The normal battery is not big enough to drive some of these systems. We have cars with multiple batteries and take a 35- or 55-amp alternator and get it to put out somewhere between 80-130 amps. Your biggest current drain is on the bass notes."

What about interference? "One of the secrets is to run your power wires on the opposite side to your signal leads."

And what about insulation — is it needed? "With so much power you don't hear anything else. But in some cars we're doing a lot of fibreglass reinforcement behind door panels."

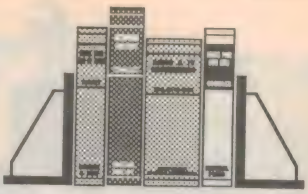
How about body noise? "As soon as we put subwoofers in the cars, we often have a real problem with the rear number plate. It's always the rear!"

How do you get acceptable stereo imaging? "That's very critical. It gets back to cosmetics. Ideally, the two door speakers should not fire into each other, but be offset. We try to mount all our speakers off-axis and fire them to an imaginary centre point of the car."

And down the road? In Japan, Alpine have a four-inch TV that folds back into the tuner unit. And Graham Humphries expects we're going to see more cars using satellite navigation systems.

For those times when you get completely lost in the music! ❖

NEW BOOKS



Using capacitors

THE CAPACITOR HANDBOOK, by Cletus J. Kaiser. Published by Van Nostrand Reinhold, 1993. Hard cover, 235 x 135mm, 124 pages. ISBN 0-442-01558-5. Recommended retail price $57.95.

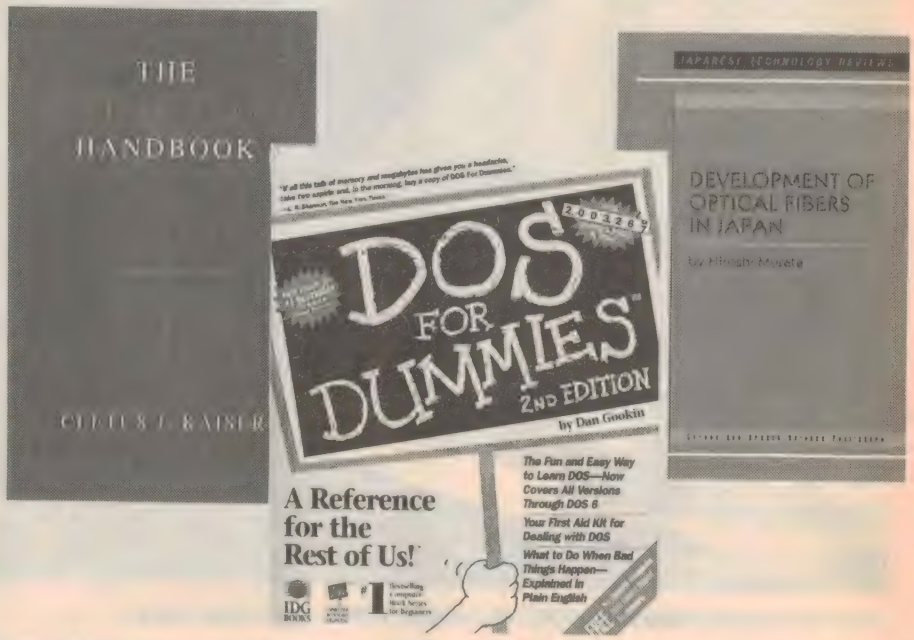
The author believes that 'capacitors are the most misunderstood and misused electronic component. This book provides practical guidance in the understanding, construction, use and application of capacitors'.

The first chapter deals with the fundamentals of all capacitors, while the next six treat different types of capacitor, based on the different dielectrics used: ceramic, plastic film, aluminium electrolytic, tantalum, glass and mica. Chapters 2-7 are all organised in the same way — the theory of the dielectric type is followed by circuit application information.

There is also a nine-page glossary, followed by two appendices. The first of these gives very useful guidelines for capacitor selection, summarising typical values, tolerance, voltage rating, dissipation factor, temperature coefficient, uses, limitations, etc.

The book is very easy to read and all technical information is clearly explained, with plenty of graphs and diagrams. Appendix B lists the relevant equations and symbol definitions needed to understand the theory.

The review copy came from Thomas Nelson, 102 Dodds Street, South Melbourne 3205. It should be available from technical bookshops. (P.M.)



DOS explained

DOS FOR DUMMIES, 2nd Edition, by Dan Gookin. Published by IDG Books Worldwide. Soft covers, 235 x 188mm, 316 pages ISBN 1-878058-75-4. Recommended retail price $34.95.

Although I've been using computers for years, I am basically a very impatient sort of person and have never yet been known to read the operating instructions first (or even second). Consequently my knowledge of DOS is very limited.

However, this book is different to the normal manual, as is apparent from the title. After you get over the chuckles and outright laughter at the chapter headings and explanations, you find that you have actually learned something about DOS. Who could resist reading a chapter titled 'Background Information Worth Skipping'? or 'What You're Not to Read'?

Explanations are written in everyday language that you can read without having to resort to the dictionary, thesaurus and encyclopedia, with the added bonus of being amusing. The book takes you firmly by the hand, and leads you step by step through the jungle of commands and responses, to where you want to go.

This book has given my curiousity a jolt and should appeal to anyone with a sense of humour regarding their inability to reason with computers. The review copy came from distributors Woodslane, but you should find it at most bookstores. (M.R.G.)

Fibre optics

DEVELOPMENT OF OPTICAL FIBRES IN JAPAN, by Hiroshi Murata. Gordon and Breach Science Publishers, 1989. Soft covers, 214 x 140mm, 154 pages. ISBN 2-88124-372-X.

This is another monograph in the Gordon & Breach series entitled Japanese Technology Reviews, designed to give an overview of the status and future prospects of Japanese technology. The author of this monograph is with the Furukawa Electric Co., and here presents a compact treatment of the history of optical fibres, the various current techniques for manufacturing them (in considerable detail), and emerging special types of fibre.

As with previous monographs in the same series, it is very concise and informative. A surprising amount of data is given, considering the book's compact size — largely by the use of diagrams, tables and graphs. In addition, the second and third sections each close with a comprehensive list of references, which should save a lot of time for anyone wishing to delve further into the subject. The two main technologies discussed are the MCVD (modified chemical-vapour deposition) and VAD (vapour-phase axial deposition) processes, incidentally.

Although this publication is now a little dated, it would probably still be a good starting place for anyone wanting to study optical fibre technology. The review copy came from G&B in New York, but the address of their local office is Private Bag 8, Camberwell Vic 3124. The American 'Science & Arts Society' price is US$36. (J.R.) ❖

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HOW THEY MADE THE ATOMIC BOMB - 1

This year marks the 50th anniversary of one of the most significant events in world history — the start of the nuclear age. Many would say it was also one of the most terrible events, since the first the public saw of nuclear power was the destruction of two Japanese cities, Hiroshima and Nagasaki. But good or bad, the development of the atomic bomb was one of the world's great adventures — centred upon the common effort of some of the greatest technical minds in history.

by TOM MOFFAT

In this series of two articles we will re-live the birth of the bomb, from information I gathered during a journey to New Mexico a few months ago. Sources include museum exhibits, chats with some of the people who were directly involved at the time, and memos and reports from the hitherto top secret files of the Los Alamos Scientific Laboratory. In this first part we will look at Los Alamos, the city that didn't exist. In the second part we will describe the development of the atomic bomb itself.

"The nuclear age was heralded by the explosion of the first atomic bomb at Los Alamos, in the New Mexico desert." Right? Wrong. That line came from a recent Australian report on the subject, but they got their geography a bit mixed up.

Had the bomb exploded at Los Alamos it would have been the end of the project right then and there, because Los Alamos was a town of 5000 people, built to house the scientists working on the bomb's development. The first bomb was actually exploded at a place called Trinity Site, a couple of hundred miles *south* of Los Alamos.

At the time this all this was going on, I was living at Albuquerque, about halfway between Los Alamos and Trinity. I was just a baby at the time, but at least I can say I was there. I remember it more after the end of World War Two, when work was pressing forward with hydrogen bombs. Secrecy was intense, and even five year old kids never spoke openly of 'Los Alamos'.

From the day the Los Alamos Scientific Laboratory opened on April 15, 1943, it was known cryptically as 'The Hill'. I remember later conversations with my school friends:

"Are we still going fishing this weekend?"

During his recent trip to Los Alamos, Tom visited a museum where replicas of the first atom bombs were on display. He couldn't resist the temptation to emulate Dr. Strangelove — and even conned an attendant into taking this photo for us!

"No, Dad's gone to The Hill."

"Oh." And that would be the end of the conversation. One would not ask when Dad went to The Hill, or how long Dad would stay there. Even among primary school boys, who would openly discuss an unauthorised dissection of a horned toad, or what they saw peeking into the girls lavatory, discussion of The Hill was totally *verboten*. It just wasn't done in our society. And to actually use the term Los Alamos was more shocking than the worst four-letter swearword.

The reason, of course, was that several military facilities in Albuquerque were closely allied with Los Alamos. Research and design work was done at Los Alamos, but many designs, particularly bigger items, were fabricated in Albuquerque. If some kid went into detail about his father's travels, and if Base Security found about it, the kid's father could very well find himself out of a job. Or worse, on trial for treason. We didn't talk about The Hill.

Even during my recent visit I found that old habits die hard. Occasionally when I would mention to one of the old-timers that I was trying to get together a magazine article about Los Alamos, I would sense a faint resistance, as if I were opening an old, long-forgotten wound. "What do you want to do that for?", they would say. The implication was that it's best to let sleeping dogs lie. And those who spoke would only speak of 'The Hill', never of Los Alamos.

Ah, what a weird set-up was Los Alamos. The place began life as the Los Alamos Ranch School, a rough-and-tough school for well-to-do boys. Although it was some 7000 feet up in the mountains, the boys wore shorts the whole time, summer and winter. In fact their school uniforms looked much like our present-day Boy Scout uniforms. In order to ensure plenty of fresh air, the boys slept on screened-in verandas with no windows.

Although I've never seen it, I suspect the present-day Timbertop facility in Australia, run by Geelong Grammar School, would be a lot like the Los Alamos Ranch School.

The site was on a flat ridge of land, which in New Mexico is called a 'mesa'. This dropped off abruptly to a deep

Enrico Fermi, one of the team of physicists who developed the atom bomb at Los Alamos.

J. Robert Oppenheimer lead the scientific team, with security looked after by General Leslie Groves.

canyon. The only way to get to the mesa was along a tortuous road that wound its way up the canyon wall. The mesa structure, perched as it was above its surroundings, led to the name 'The Hill'.

How it began

The idea for a bomb project was germinated before America even got into World War II. In the late 1930's, almost simultaneously, American and German scientists discovered that radioactive materials could be made to undergo fission, or division of their atoms approximately in half, with a small portion of the matter turning into a tremendous release of energy. With a sufficient quantity of material, fission could be made self-sustaining as a 'chain reaction', and if this happened fast enough it was thought an enormous explosion would result.

With the war under way, the American military establishment didn't take the nuclear explosion theory all that seriously, but the British had been working along the same lines.

They soon became convinced that the war could be ended almost immediately if America would develop and demonstrate an atomic bomb. Australia's Sir Mark Oliphant, who was a kingpin in the British scientific effort, was sent to the USA to twist a few military arms. It worked.

So an atomic bomb was on the cards, and the thinking was that if the USA didn't develop a bomb fairly quickly, Germany certainly would. Thus the American military set up an atomic bomb development project, called the Manhattan Project, under the leadership of General Leslie Groves.

The study into atomic fission involved complex principles of nuclear physics — certainly not the area of expertise of a hard-nosed Army general. Leadership of the scientific side of the project fell on the shoulders of J. Robert Oppenheimer, assisted by other well-known names such as Enrico Fermi and Neils Bohr. All these names were right up there with Albert Einstein, who postulated the matter-to-energy transformation in the first place.

For nearly four years, nuclear fission work had been going on at widely scattered laboratories, but then General Groves decided it should all come together at one site, to be as isolated as possible to preserve secrecy. General Groves, Oppenheimer, and a couple of others eventually went prowling about in a jeep to find such a place. Oppenheimer had remembered some pleasant touring in the Jemez (pronounced Haymes) Mountains in northern New Mexico, and he directed the others there. After a bit of scrub-bashing around the back of the mountain range they tumbled into the Los Alamos Ranch School by the back entrance, and Los Alamos Scientific Laboratory was born.

It wasn't long before the Ranch School was closed down (important government business, you know) and taken over by the Army. The buildings were made of logs and very rustic — not the sort of stuff Army camps are made of. But some were kept in use, particularly the main school building which survives to this very day as the delightful Fuller's Lodge. This was used for VIP visitors in the early days, and for not-so-important people later on.

From the first day Los Alamos Scientific Laboratories opened, there was terrible friction. General Groves wanted to run it as a military base (which in fact was what it was), while J. Robert Op-

How they made the Atomic Bomb - 1

A picture showing the tortuous road leading up to the Los Alamos facility on 'The Hill', in 1942 or thereabouts.

penheimer saw it more as a university academic facility. Groves wanted a strict, almost boot-camp atmosphere, while Oppenheimer wanted families to accompany scientists, with decent housing for everybody.

For a while General Groves won out, and with the strict security screen he erected Los Alamos simply didn't exist when viewed from the outside. Scientists who were hired for the Manhattan Project were told they were going to work in New Mexico, and that's all. They were told to report to Room 8, 100 Palace Street, in Santa Fe, New Mexico's capitol. They were then bussed or guided to The Hill, 35 miles away, where for all practical purposes they simply disappeared.

Those who expected to arrive at Santa Fe by train never got there at all. The nearest the train came to Santa Fe was a place named Lamy, 20 miles away. Scientists were met by old friends or colleagues, or by army personnel in civilian clothes, and taken straight to Los Alamos. Again they disappeared.

For a while the only communication with the outside world was by mail through one common address — PO Box 1663, Santa Fe. Only close relatives could be told the correspondent was working in New Mexico.

Surprisingly there was no censorship of mail during the early stages, although later on General Groves felt this loophole should be closed. Oppenheimer eventually agreed with the censorship plan, which was also ratified by his senior staff as a necessary evil. All mail was then opened and read in the small office at 100 Palace Street in Santa Fe.

New arrivals to The Hill ground their way up the horrendous mountain road, eventually to be confronted with a giant timber watchtower with a small guardhouse at its base. It looked for all the world like a horror vision of a prisoner-of-war camp. And that's most likely what the scientists felt they were being carried into.

But inside — well, it was rough, but life was happy, if not easy. Because of the intense security the roads didn't even have street signs, and the buildings didn't have addresses. If you invited someone to come visit, you told them to come to the flat 'two streets north and one east of the water tank'. The roads were more like muddy tracks and the 'homes' were mostly Nissan huts.

Wives of prominent scientists had previously lived in such salubrious places as Berkeley, California, where they had all the 'mod-cons' like central heating and gas cooking. But on The Hill they found they had to revert to the cast iron wood-burning cooking stoves of their grandmothers' days. The heaters ran on coal, which spewed black soot all over Los Alamos.

However there were some trappings of civilisation, such as garbage collection. But secrecy even hit the garbage men — a condition of their employment was that they be totally illiterate, lest they stumble across something sensitive in the rubbish bins.

'Bathtub Row'

Like so many 'company towns', there were two distinct residential areas: one for the bosses and one for the workers. While the workers wallowed in the mud, the laboratory leaders such as Oppenheimer lived in former staff homes from

An early Los Alamos experimental set up, with the ubiquitous yellow tape in evidence here and there, to lash things together.

the Ranch School. These houses had the only bathtubs on The Hill, so the area became known as Bathtub Row.

Single people lived in large dormitories, with separate buildings for men and women. At least that was the official situation. 'Company' towns all over the world are notorious for their lack of women. When a single man signs on to work at one of these places, be it a mining town or a missile test range or a defence installation, one of the things he sacrifices in return for high wages is female companionship.

But while the Manhattan Project was under way a war was raging as well, and many male Army personnel were posted overseas. So this left a large contingent of WAC's — Women's Army Corps — to join the young scientists and technicians at Los Alamos. And join them they did.

Social life on The Hill was absolutely fantastic. There were army-style 'night clubs', cheap drinks and dancing until the wee small hours, after which couples would retire to more private surroundings to get to know each other even better. Many of these liaisons resulted in marriages and families that remained part of the Los Alamos scene long after the war ended.

Good times on 'The Hill': a picture in the staff canteen showing the friendly atmosphere that prevailed. Note the classic Wurlitzer juke box on the left.

Still going today

The Los Alamos Scientific Laboratory is still going strong today, involved in things such as cryogenics research. Most of the tight security is gone, although there are still pockets of no-go areas. What they are up to there is anyone's guess, although one could realistically assume it is defence-related (Star Wars?).

I clearly remember when the gates on The Hill came tumbling down, back when I was in high school in Albuquerque. That forbidding guard house was turned into — would you believe — a drive-in restaurant, just like you see in those old 1950's movies, with car-hop waitresses charging around on roller skates.

By then the town had developed a nice shopping centre, and it even had its own radio station, with its transmitting antenna right in the middle of the shopping centre square where anyone could walk up and touch it. I wonder how many RF burns it caused? The streets had been sealed, and the old Nissan huts had been replaced with some very nice homes that blended in well with their alpine setting.

Los Alamos High School, back in my own high school days, had the highest IQ rating among its students of any high school in the USA. This was attributed to the fact that they were the children of the marriages between the scientists and the WAC's working on the Manhattan Project.

Some people say intelligence is not inherited, others say it is. It would be interesting to do a proper genealogical study of the entire Los Alamos population to see what became of them.

During my early working life I had the pleasure of spending the occasional week on assignment at Los Alamos. At that stage some of the gear from the old Manhattan Project days was still there, and still in use.

The original 'water boiler' nuclear reactor was still cooking away, with numerous experimental projects plastered to it with Yellow Tape (See Moffat's Madhouse, February 1993). The woman who operated it as a member of the WAC's back in the 1940's was still there, tending 'her' nuclear reactor.

In another wing of the same building was a new reactor, again adorned with lashings of Yellow Tape. Once I was al-

Typical Los Alamos living quarters in 1943. The Nissan hut buildings were linked by boardwalks to avoid tramping through too much mud.

How they made the Atomic Bomb - 1

lowed to look down into it, through a hatch in the top. The reactor core sat submerged in several metres of water, causing the water to glow a most ghastly blue. I thought I'd looked into the pits of hell; I'll never forget it.

The new reactor was operated from a separate room, via a giant control panel that swept around three sides of the operator's desk.

It was filled with lights and switches and meters, and in the very centre it had an enormous red button labeled 'SCRAM'. This was supposed to shut down the reactor in an emergency by dropping all its control rods into the core, snuffing out the reaction.

This reactor complex, along with some labs and machine shops, was situated at the bottom of a deep canyon adjoining the Los Alamos township. The idea was that if one of the reactors went out of control and blew up, the explosion would go straight up, instead of wiping out the town. Hopefully...

Super women!

We slept and ate at Fuller's Lodge, except for lunches which we took at the large Los Alamos staff canteen. And one thing that always struck me in that canteen was the disproportionately large number of young, beautiful women who ate there.

Some were scientists in white lab coats, others were dressed as secretaries. And friendly! As we'd walk in with our full trays they'd wave us over to share tables with them.

Were these lovely ladies the descendants of the Manhattan Project scientists and WAC's? The same ones who'd populated the high school earlier? Yes, they said, many had been born here. It makes one wonder — the world was busy fighting against Hitler who wanted to breed a super race, and maybe this was already happening, accidentally — by the coming together of the best brains in the world at Los Alamos.

Although many people don't like its 'company town' atmosphere, Los Alamos remains one of the most beautiful towns in the USA, with its setting high in the Jemez Mountains. Living there is said to be just as great as it was in the early days. And to prove it, some of the early 'Hill' families are still in residence, 50 years later, enjoying their retirement.

It's not even necessary to wind your way up that road along the canyon wall any more. Los Alamos now sports its own airport, and flying in and out of there is a real adventure in itself. I used to make occasional trips to Los Alamos in an old DC-3, probably the only large aircraft with enough grunt to survive this unique experience.

The runway was all of about 3000 feet long, on a slope, dropping off at the low end into a canyon. No matter what the direction of the wind, the DC-3 always landed going uphill so gravity could help stop the aircraft before it went charging off into the trees. No problem.

Taking off was a different matter. The plane would start at the high end of the runway and then roar down the hill. It would never reach take-off speed before it ran out of runway, so it would simply plunge over the cliff into the canyon. In a steep dive, the plane would then pick up speed so the pilot could regain control before the plane hit bottom. As far as I know, no aircraft was ever lost in this way — but they sure went through a lot of sick bags!

In the next article we'll look at the technical side of how the atomic bomb was developed at Los Alamos, leading up to its successful test at the Trinity site. You'll meet some interesting characters — Little Boy, Fat Man, and Jumbo. Stay tuned! ❖

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READER INFO NO. 7

Exciting new satellite navigation product:

ICOM'S GP-22 HANDHELD GPS RX

Best known for its amateur and mobile/marine radio communications equipment, Japanese firm Icom Inc has now applied its expertise to produce a very compact handheld satellite navigation receiver based on the US Global Positioning System. Now virtually anyone can use GPS to determine their exact location on the earth — whether they're out in a boat, cross-country skiing, tracking through the desert or exploring the bush.

by JIM ROWE

Icom's new GP-22 handheld GPS satellite navigation receiver is surprisingly small, measuring only 131 x 65 x 35mm and weighing only 330 grams (including the rechargeable battery).

This is all the more remarkable when you realise that inside this tiny package is a satellite receiving antenna and front end, together with a complete GPS processing system and navigation computer.

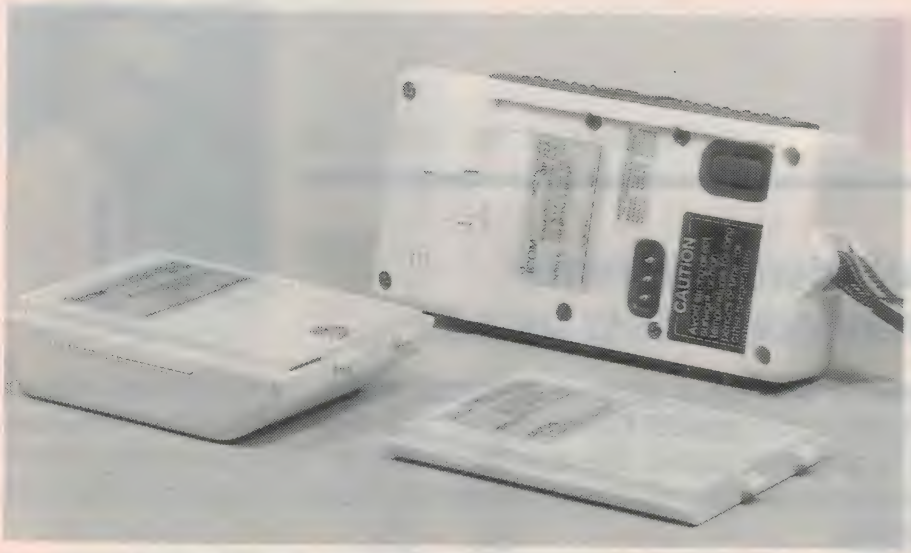
What this means, of course, is that the precise positioning and navigation provided by the US Navy's GPS system is now in principle available not just for those in boats, aircraft and land vehicles, but also for someone on a bicycle or even on foot. The GP-22 is so tiny that you can slip it in a back-pack, a waistband or even a hiking jacket pocket.

Despite its tiny size, the GP-22 has a five-channel parallel receiving system which is capable of tracking the 1.5GHz signals from up to five GPS satellites at the same time. This means that it can produce a position 'fix' relatively quickly, compared with receivers which have fewer channels. Once it has collected an 'almanac' or updated reference to the current satellite configurations, it can provide a new fix in less than three minutes.

To ensure that the positional information provided by the GP-22 is accurate for each country, it has a built-in database with the geodetic 'datum numbers' or correction factors for some 93 different regions — according to the WGS84 World Geodetic System. All you have to do is punch in the code number for the region or country you're in, and it does the rest.

Both two-dimensional (latitude/longitude) and three-dimensional (2D + altitude) positioning are available, with the 3D fix taking a little longer. In addition the GP-22 can perform a range of navigation functions — destination and route navigation, calculation of course and speed over ground (COG/SOG), cross track error, estimated time of arrival, bearing and range to a waypoint and so on.

That's not all, either. As a bonus it can also provide accurate time and date indication, with the time updated from the satellites when you take each new fix. The time can also be indicated in either local or UTC, as you wish.



At upper right in this photo is the battery charger supplied with the GP-22, with the compact nickel/metal hydride battery pack below it and the larger pack which takes five AA alkaline cells to the left.

You also have a choice of units, when it comes to latitude/longitude, altitude and speed/distance. The first can be displayed in either degrees, minutes and hundredths of minutes, or alternatively degrees, minutes and seconds. Similarly altitude can be displayed in either metres or feet, while distance/speed can be displayed in terms of either kilometres or nautical miles.

In short, it's a very powerful and flexible little unit.

Operation of the GP-22 is fairly straightforward. There are only six function buttons, apart from a push-on push-off power switch on the side. All of the functions are accessed and programming performed using the buttons and the GP-22's two-line LCD panel, using a system of menues. The initial menu has four mode selection options (POSition, NAVigation, CONFirmation of route status and PROGramming), each of which has a further sub-menu or two. It's all quite logical when you grasp the basic concepts of what the GP-22 is capable of doing for you...

The receiver is capable of operating from two different battery packs, one a very compact pack using a nickel/metal hydride rechargeable battery, and the other a little larger and taking five AA-size alkaline cells. A battery charger is provided for the Ni/MH pack, together with both an AC adaptor and an adaptor cable for a car's cigarette lighter socket.

Icom's quoted operating times for the GP-22 in continuous use are 80 minutes with the Ni/MH pack, and 300 minutes with the five AA cell pack. These times

Continued on page 32

GPS and how it works

The Global Positioning System or 'GPS' was conceived by the US Air Force in the early 1970's, as a way of achieving pinpoint navigational accuracy anywhere on Earth. Officially known as NAVSTAR GPS (NAVigation System with Timing and Ranging), the full system will use an array of 24 Rockwell satellites, and these are expected to be in place by the end of this year.

Each of the satellites rotates around the Earth every 12 hours at an altitude of 10,900 nautical miles, in orbits inclined at 55° to the equatorial plane.

GPS is a time-delay triangulation ranging system, using signals transmitted from the satellites on two carrier frequencies: 1575.42MHz and 1227.6MHz, in the UHF/microwave 'L' band.

The transmitted signals use spread-spectrum technology and consist of special pseudo-random binary code sequences (PRBS), with accurate timings derived from on-board atomic clocks. Each satellite has its own characteristic PRBS, allowing them to share common frequencies.

A receiver for GPS uses the signals from a number of the satellites, comparing their exact timing to determine its distance from each. This allows the receiver to determine its own position, knowing that of the satellites.

The more elaborate GPS receivers have multiple receiving channels, and can compare the signals from two, three or four satellites in real time. This allows them to give faster results, and also to provide information on speed and course heading as well as location. Simpler receivers generally have a single receiving channel, and use time multiplexing to receive and compare the various signals needed. This makes them slower, and usually only capable of specifying location.

Digital auto-correlation techniques are used in GPS receivers, to perform signal averaging of the PRBS codes and allow reliable operation with very low signal levels; this in turn allows the use of very small receiving antennas.

To justify the massive US$10 billion cost involved in setting up the GPS system, the US Air Force agreed to allow it to be used for civilian as well as military purposes. To allow this to be done, there are actually two differents levels of PRBS signal transmitted from the GPS satellites.

The signal available for use by civilian GPS receivers is known as the 'C/A' or *clear acquisition* code, while that which can only be accessed by military receivers is the 'P' or *protected* code.

The C/A codes use a PRBS length of 1023 bits, biphase modulated on each GPS carrier at a rate of 1.023MHz. These sequences therefore repeat every millisecond.

In contrast the P code uses much longer PRBS lengths, again biphase modulated on the carriers but in this case at a rate of 10.23MHz — 10 times that of the C/A code.

The P-code sequences apparently only repeat every 267 days or so, but each one-week segment of this code is unique for each GPS satellite, and is reset weekly.

The accuracy available to military users using the P code is said to be 'within inches' — particularly when *differential* techniques are used with multiple receivers. The P code is also said to be virtually impossible to jam.

A good civilian GPS receiver using the C/A code will typically be able to determine its location to within 20-30 metres anywhere on the earth's surface or in the atmosphere, when stationary and once the full complement of GPS satellites is operational.

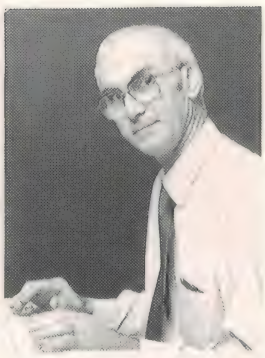
However the US Air Force can deliberately degrade the accuracy available using the C/A code, using an operational mode known as *selective availability* or 'S/A'. This adds programmed clock timing errors to the transmitted C/A codes, with the idea of hampering use of the GPS system by enemy forces in time of war.

Only 'friendly' GPS receivers provided with the necessary enciphering 'key' are able to maintain their accuracy when the S/A mode is activated. All other receivers using the C/A code have their accuracy degraded by a factor of around four or five times.

The GPS system is recognised as having enormous potential for improved navigation and location on land, sea and in the air. Receiver size has already been reduced to the hand-held level, and still smaller receivers are predicted.

FORUM

Conducted by Jim Rowe



Fancy cables, fanciful power systems and how manufacturers could help us all...

This month we're going to give another bounce to some of the topics which have featured here in the last few months — including fancy audio cables, listening tests and how that ill-fated 'tethered satellite' of NASA was supposed to generate power. We also let Mr Comer have a last say about back EMF, and look at an excellent suggestion that all manufacturers of electronic equipment should provide schematics with their products.

I don't know about you, but I think we've just about exhausted the topic of back EMF. We certainly haven't reached any kind of consensus on the topic, of course — not even the kind defined by our former Prime Minister, where everyone decides to live with the solution, even though no-one likes it.

In this case the pro- and anti-back EMF camps just don't seem to be able to agree at all. But everyone seems to have run out of puff, when it comes to arguing — perhaps they've all been stunned by Mr Mainwaring's high-powered maths, last month. So I guess we'll just have to agree to differ...

Before we close the subject, though, I've received a further letter from the chap who started this argument in the first place: Arthur Comer. So let's allow him to have the final say:

You invited me to respond on the relay current question. Your own analysis was 100% correct. Due to the changing inductance, the current first rises and then falls, before the final, slower, rise.

I remain unrepentant for putting 'idiosyncratic' (I would have said iconoclastic) views on 'back EMF'. The correspondence (June EA), was very interesting, though clearly I cannot agree that the voltage across a charging inductor is an EMF. Nor can I accept that the term EMF is out of date, as suggested by Mr Gordon Wormald. I don't wish to comment on all the points made by your correspondents, but some were plainly wrong, and need correction.

Mr Ken Wagnitz implied no energy is involved in establishing a PD across an open circuit. Not so! Across an open circuit there must be some capacitance, however tiny, and a PD can only be produced by charging this capacitance. Electrons must move, driven by an EMF, transferring energy equal to $1/2.C.V^2$.

Mr Wormald also complains that I wrote 'IR', rather than 'RI', in a formula. References to 'IR drop' abound in electrical and electronics texts, and the Ohms Law triangle, which most of us learned, always had V over IR.

Now for three more icons. Mr Wormald, and also Mr Kevin May, invoked Lenz's Law in discussing 'back EMF'. I have seen Lenz's Law stated in a variety of ways, but believe the following expresses what Lenz said: 'When relative motion between a conductor and a magnetic field causes a current in the conductor, that current will produce a magnetic field of such direction as to oppose the motion which produced the current'. Very simple — you can't get energy out without doing work.

I can't see any connection between Lenz's Law and the PD across a charging inductor. Perhaps someone can explain. Mag-lev systems, on the other hand, are magnificent examples of the law.

Another icon which begs destruction is the common belief, referred to by Mr May, that inductance 'opposes' a flow of current (or a change of current); a concept I reject. I will be accused of splitting hairs, but inductors no more oppose current change than resistors oppose current flow. The correct word is 'limit', not 'oppose'. Inductors limit the rate of change of current to the value which satisfies Kirchhoff's voltage law. Resistors limit the value of current in exactly the same terms.

My final icon is the statement, found in many texts, and doubtless believed by many of your readers, that a transformer's secondary voltage is antiphase to the primary voltage; arrant nonsense, easily disproved by viewing with an oscilloscope using external sync.

Irrefutable logic says that, since both voltages are produced by the same magnetic field, cutting both windings in the same direction, they must be in phase. Again I ask, how could so many writers get it so wrong? And get their accompanying phasor diagrams wrong also. Most such diagrams show Vs anti-phase to Vp, when they should be in phase, with the currents Is and Ip (the load component of primary current) in antiphase, which accords with Lenz's Law.

Some people accept what is written in textbooks as gospel. Others, wisely, challenge everything. None of us is infallible. I would like to pay tribute to an old friend and fellow instructor at the RAAF School of Radio, and later at RMIT, who challenged me, and all of his students, to really think about what was happening in a circuit. His name was Stan Leece. No doubt many of your readers will remember him.

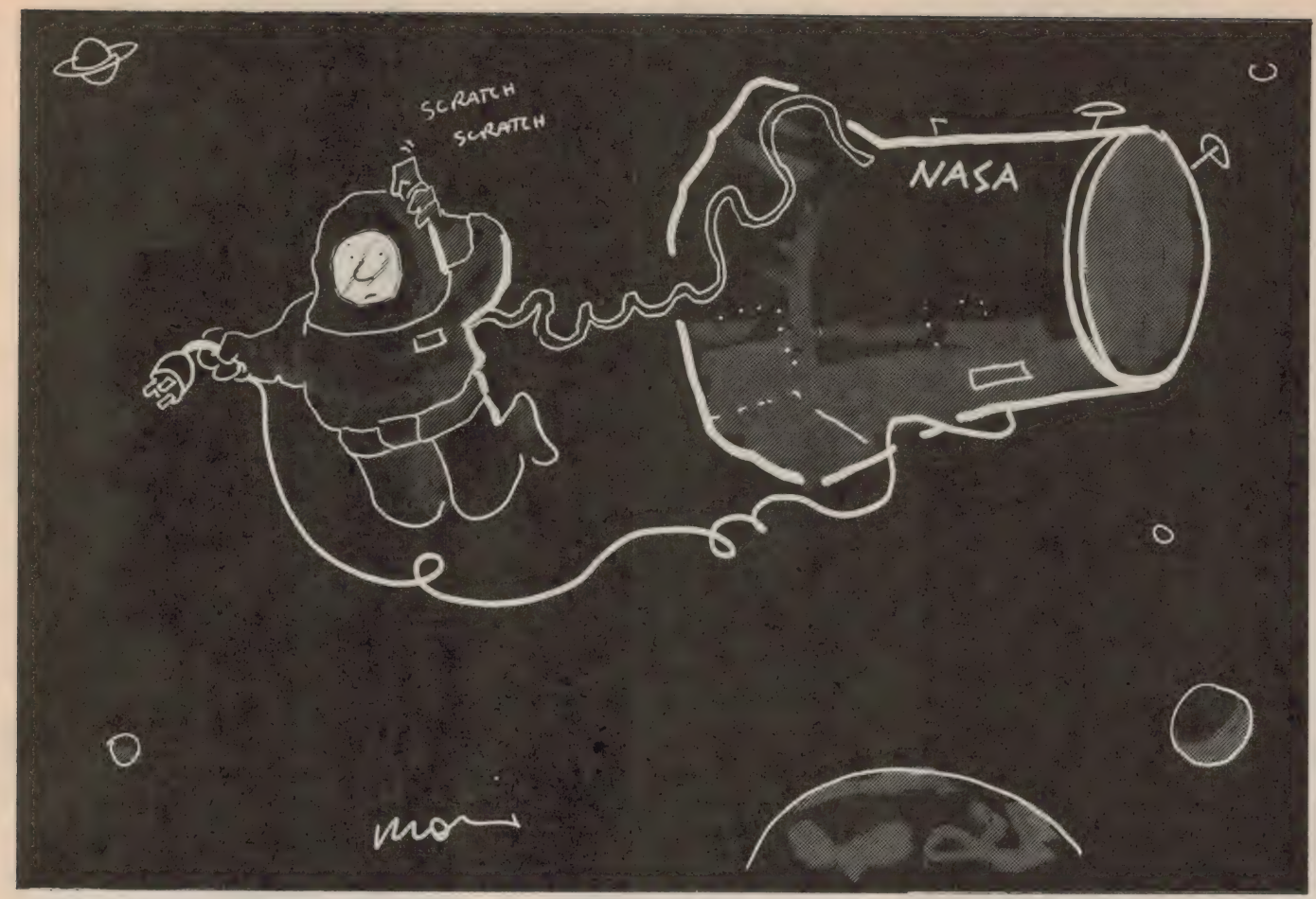
You are free to give my address to anyone who wants to improve my understanding of theory. I agree with you that a forum is a place for the putting forth of views. Keep up the good work. I will not write again unless invited to do so.

Thanks for those remarks, Mr Comer. I like your point about the need to challenge accepted wisdom, to ensure that we really understand what it means and are happy that it makes sense.

Good suggestion

Now let's change the subject. A number of times in the past, I've made the plea that in my view, virtually all consumer electronics gear should come with at least a schematic to assist in servicing it. I believe this should be mandatory, because when you buy something you should at least be given the basic information needed to look after it.

A small number of manufacturers do provide a schematic, of course. But many, perhaps most, don't. In a lot of



cases if you want to get a schematic you have to buy a complete service manual, which can cost $30 or more. Even professional service people find this a problem, I gather.

As it happens, one of our readers has a constructive suggestion to make about this. He's Mr Robert Gott, of Toowoomba in Queensland, and here's his idea:

Assuming that manufacturers don't expect us to throw away every bit of faulty gear, here's a suggestion for them to provide us with standardised schematics. It came to me whilst examining a $3 Shell Road Map (Brisbane Environs, if you are wondering!)

It is amazing how much information is contained in a 820 x 540mm double sided sheet, which folds neatly eight times down to 105 x 270mm, with about 10 colours (the resistor code is 10 colours!), with tiny crystal-clear printing.

Well, how about it, Mr Manufacturer? The 'map' would fit into most enclosures, certainly into most packing cases. If you must make a charge, $3 would be fine. Now some suggestions on the format:

Side A: The complete schematic with standard colours for power rails, signal paths with arrows, functional names against blocks, all voltages and waveforms (where feasible), and clearly indicating the condition (i.e., 'Measurements, switches & modes in PLAYBACK'), etc. It is essential that all paths, whether via subpanels or connectors, can be followed as clearly as on a map. Component VALUES must be given, not just the designation to another list. Chips to be named according to their common retail replacement. Special chips could be cross referred, 'only available from NEC, etc — no other equivalent' (wouldn't that save a lot of heartache!)

Side B: A small block diagram with arrow flows, then a short description of operation of the whole, with more essential details of the more complicated chips, power supply (not the dreaded power supply again!). All in English, I hasten to add; not multilanguage. If manufacturers cannot programme their CAD's to churn out language-specific drawings, then we have to assume that French map makers can only export maps of Australia written in French — touche!

It shouldn't have to be stated that all other details NEEDED to fix the brute are included: coil and transformer resistance values, concise specifications and more complex waveform/timing diagrams. A model number, Serial run, and date would also help.

Final comment: For those who think that three 350-page manuals are the answer, that's fine. But those that want something similar to a 'map', speak up. Until the manufacturer produces it on floppy or CD-ROM, that's what I would settle for. I can't afford a PC notebook anyway!

Well, there you are. I think Mr Gott has come up with a great idea, don't you? The only problem will be to persuade the manufacturers to do it. And this will only happen if we all speak up and apply pressure on them to do so.

We might also need to get the various consumer affairs bodies to apply pressure as well, before many of the firms are motivated to do something like this. After all, it's fairly clear than many of them are making and selling things that are quite simply not intended to be serviced.

So if you agree that Mr Gott has a good idea, why not write to your state's Consumer Affairs, and perhaps also the Australian Consumer Association. It's something they ought to be pushing for, too.

More from Phil Denniss

And now let's change the subject yet again. You may recall that in last month's column I quoted from a recent letter sent by our not-infrequent correspondent Phil Denniss, of the Department of Plasma

Physics at Sydney Uni. It was a fairly long letter, and at the time, I only extracted the comments Phil was making about the dreaded back EMF. But as well as being a fairly prolific writer Phil is also an entertaining one, and I'm sure you'll find some of his other comments of interest — even if they do touch on some of our other well-worn topics. So here's most of the rest of Phil's letter:

(Stop hiding under the table, I will be gentle). I have several things to write about, but first, you guessed it, fancy cables! As far as editing my letters goes (Forum, Feb '93), I am not fussed by it and I accept it will happen sometime. It is up to you; you are running the show (Forum), and I can do little about it anyway. Besides, there will be some situations when you must wield the editorial knife — e.g., for legal reasons.

As for being 'pretty scathing', well, I did not expect to be taken very seriously as far as the tone of the letter was concerned. I felt a bit frustrated and slightly hysterical, a bit of the 'Oh no! Not again!?' (as the bowl of petunias said on the way to Magrathea). I feel sometimes that they are not listening, and I know I do get carried away. Anyway all of the above is by way of conversation.

With regard to Eric Booth's letter in the March '93 Forum, I have a few comments (surprised?). I cannot accept his figures that you quote for the speed of propagation of signals along cables, they appear to be much much too small. It is important to distinguish between the speed of propagation down a cable and the drift velocity (average speed) of the electrons, which is much slower. I am not familiar with the values, but the figures you quote from Eric Booth's letter sound like electron drift velocity.

R.A. Greiner, in his paper which I sent you, gives group velocities (propagation velocities) of various cables at frequencies of 100Hz and 10kHz upwards of 5000km/s (i.e., 5,000,000 metres per second minimum!). Actually the equation that Greiner uses is for phase velocity, but that does not make a big difference to my argument.

Eric Booth's suggestion that cables be considered as (or nearly) waveguides I think is quite inappropriate. In cables the current flows up one conductor and down the next. In a waveguide the wave is reflected from one side to the other and it zigzags up the waveguide. The currents form small localised loops in the walls of the waveguide. It should also be kept in mind that there is a low frequency cut-off; i.e., a frequency below which propagation will not occur. This happens when the wider dimension of the 'guide equals half the wavelength of the signal in free space, and is usually above 1GHz. The wavelength of a 20kHz signal is about 16km (16,000 metres). As Greiner has pointed out, it is not appropriate to consider cables in a hi-fi setup as transmission lines; they are much much too short (or they should be!).

It should be remembered though that transmission line effects do occur at audio frequencies, in the (analog) telephone system; but here we are talking of circuits that may be hundreds or thousands of kilometres long. The problem is caused by different rates of propagation at different frequencies, and it is cured by putting loading coils in the line at regular intervals. Greiner addresses this matter, and he sums it up by saying that 'the delay time, or frequency dispersion, is certainly not a problem for loudspeaker cables of any reasonable length'.

Moving on to Dan Dempsey's letter, he seems to think that giving a money-back guarantee with the 'controversial power cable' (top RH corner, p42 Forum Feb '93) is some indication of the retailer's honesty and faith in the product he sells. It could as easily be an indication of the retailer's ignorance, and/or faith in the gullibility and ignorance of the general public.

I think that the money-back guarantee is hardly more than that which is furnished to the purchaser as their legal rights, and in fact might be intended to defeat some action taken by disgruntled buyers. I think that this is an irrelevant point as far as the debate is concerned; it is proof of nothing. Besides it fails to cope with the possibility that the retailer (and the manufacturer for that matter) may be entirely ignorant of the truth and may be innocently selling (or making, in the case of the manufacturer) the cables on a false assumption.

Dan Dempsey mentions battery powered preamps in his PS, and says that their performance is not up to scratch. There are some good reasons why this may be so, mostly due to poor design. Battery operated equipment usually has to run at low supply voltage and very low current to preserve battery life. This can lead to limited bandwidth, low slew rate and low output drive capability, which can in turn lead to higher distortion.

It is hardly surprising (to me anyway) that battery powered equipment would have trouble matching the performance of mains operated equipment, while at the same time delivering acceptable battery life, all at a reasonable cost and with little inconvenience. (The first rule of battery operated equipment is that the batteries will go flat just when you want to use it.)

As for listening tests, one should bear in mind that to test these fancy power cables one would need two amplifiers and two pairs of speakers, all of which should be certified to be otherwise identical, and set to identical signal levels, with both pairs of speakers in exactly the same place (a bit tough without Dr Who and his Tardis).

Well, we would have to accept some compromise I guess. The equipment and the setup will obviously be quite extensive (I might be convinced to lend a hand), and the tests would be quite time consuming. Who has the resources for such a venture? I certainly do not.

A point that I feel is not often appreciated with regard to listening tests, is the interpretation of the results (assuming that we have them). Suppose the listener had to choose the best system from a choice of two. Some of the time the listener will get it right, sometimes wrong. Sometimes the listener will get it right for the wrong reason, and sometimes vice-versa. For this reason the listener has to get it right significantly more than 50% of the time to be able to draw a valid conclusion.

It is like saying that you can tell what the outcome of an unbiased coin toss will be. Nobody can in fact; the nature of chance says that you can guess correctly half the time, but we cannot predict the outcome (apart from saying 'It will be heads or tails' which is valueless). The same principle applies to the listening tests, i.e., the listener has to identify the superior performer significantly more than 50% of the time to be able to conclude that the listener can identify which is superior. For this reason many listening tests done by amateurs are pretty valueless.

Listening tests will show up gross differences and they may provide some qualitative measure. However most anecdotes of how special cables improve the performance of a hi-fi system are just about worthless, particularly where the differences are small. A piece of music played on a particular hi-fi can easily sound different to someone from one day to the next.

And now for the gymnastics! Here is a little idea I got from a colleague of mine, a simple idea for a listening test setup especially for trying out fancy interconnecting cables. I should have sent it to you earlier, but you know how some things fall off the back when your attention is elsewhere. I am indebted to Vic Buriak from CSIRO for this idea.

My ole mate Vic was at a party and

Reader John Rich, of Petersham in NSW, sent in this picture to illustrate an amusing but true story. As he says, it illustrates only too well the truism that anyone who leaves a computer printer working unattended, will do so only once. John was printing out a file one night when he heard the sound of tearing sprocket holes. When he stopped the printer and examined the tractor feed, he couldn't find any evidence of jamming; but when he tried checking the tension of the paper coming up from the box under the table, it was very tight indeed. When he reached underneath, the cause of this became apparent: Calico, his pet cat, had climbed into the box for a nap. With a weight of about six kilograms, the cat produced rather more paper tension than the printer's tractor feed could cope with...

was chatting to one of the other revellers about fancy speaker cables. Vic is, like me, pretty sceptical about the benefits of using such exotic (and very expensive) cables, and proposed a simple test. They went back to the reveller's house and set up the hi-fi by switching the amp to mono, wiring one speaker with the old cable and the other with the new fancy cable, and placed the speakers as close together as possible. They then listened to the system while using the balance control to select left or right channel — i.e., the ordinary cable or the fancy cable. As it turned out they both admitted that they could discern no difference between the two.

I am not suggesting that this proves or disproves anything, but it is a simple and inexpensive method that will indicate any reasonable differences that might exist. It is important to keep the speakers as close together as possible, in such a way that neither speaker may be adversely influenced by anything else in the room. To this end they should be placed as far away from the floor, walls, ceiling, and furniture as possible.

If possible both channels should be checked so that they deliver the same signal to each speaker. The human ear is completely inadequate for this task; use a good meter with a sinewave generator. The tests should be done blind to the listener, although this might not always be possible. If the result is not convincing one way or the other then the result is inconclusive (no result).

Finally, 'Satellite Power' (p31, Forum Mar '93). I think that the idea was to gather power by exploiting the fact that the 'soup' that is sometimes considered a vacuum is chokkers with charged particles, like a plasma, and there is usually a potential difference between any two points in space. I am not a physicist so I am not sure, but I think that all there is to it is to connect your load between two points in space at different potential.

Believe it or not, even though I spend day after day in a big old building brimming with brains that should have all the details, I have not been able to get confirmation of this. Assoc. Prof. Rod Cross agreed that this may be the mechanism entailed, but his interests are more down to earth (just HAD to slip that in!) and so he was unable to confirm it. The electron gun would be used to make one of the connections to the system, i.e., space.

I seem to remember reading somewhere that the sun was many megavolts with respect to earth, and all we had to do to collect power was to connect a load between the two somehow. The suggested method was to use a gamma ray laser (GRASER) to ionise the intervening gunk, to provide a current path; unfortunately I do not know of anyone that has been able to fabricate such a device.

FORUM

So that's all folks. I thank you for your time. So until I write again, it is 'Oh reservoir!' (It's French, I'm told.)

Well, as you can see Phil was in fine form when he wrote that lot. Thanks for your comments as usual, Phil, and I'm sure you're right about the distinction between electron drift velocity and signal propagation velocity along a cable.

You might recall from the March column that I also expressed considerable doubt about Eric Booth's suggestions likening the behaviour of audio cables to transmission lines and/or waveguides. So we seem to agree on this one, at least!

Your comments about the validity of listening tests are very sensible, I think. In any testing like this the effects of chance must be allowed for, and this means that for the results to have any real significance, the test really needs to involve a lot of comparisons by a lot of people. The results then have to be analysed using the usual statistical methods, to determine the likelihood of there being anything 'real' involved. As you say, this tends to make most listening tests a bit of a joke.

That tethered satellite...

Finally, there's your comment about that ill-fated NASA tethered satellite experiment. Perhaps you're right, and they were merely trying to sniff out any EMF/PD/voltage difference (everybody happy?) that may already exist in our upper atmosphere — not use Lenz's law to convert their mechanical kinetic energy into electrical energy.

I'm not so sure, though. Here's a quote taken directly from NASA's press kit for the STS-46 Shuttle Mission, which they sent to us at the time:

The tether's length and electrical properties affect all aspects of tethered operations. For the TSS-1 mission, the tether will be reeled out to an altitude about 12 miles above the Shuttle, making the TSS-1/orbiter combination 100 times longer than any previous spacecraft. It will create a large current system in the ionosphere, similar to natural currents in the Earth's polar regions associated with the aurora borealis. When the tether's current is pulsed by electron accelerators, it becomes the longest and lowest frequency antenna ever placed in orbit. Also, for the first time, scientists can measure the level of charge or electric potential acquired by a spacecraft as a result of its motion through the Earth's magnetic field lines. All these capabilities are directly related to the structure of the bootlace-thick tether, a conducting cord designed to anchor a satellite miles above the orbiter.

The TSS-1 tether is 13.7 miles long. When deployed, it is expected to develop a 5,000-volt electrical potential and carry a maximum current of one ampere.

As you can see, they themselves seem to be a bit vague and ambiguous when it comes to the exact mechanism involved in generating the voltage in the tether. This isn't clarified later on in the press kit booklet, where they describe the 'Shuttle Electrodynamic Tether System' (SETS) experiment, which was attributed to a Dr Peter Banks of the University of Michigan in Ann Arbor:

This investigation studies the ability of the tethered satellite to collect electrons by determining current and voltage of the tethered system and measuring the resistance to current flow in the tether itself. It also explores how tether current can be controlled by the emission of electrons at the orbiter end of the system and characterizes the charge the orbiter acquires as the tether system produces power, broadcasts low-frequency radio waves and creates instabilities in the surrounding plasma.

The hardware is located on the support structure in the orbiter cargo bay. In addition to three instruments to characterize the orbiter's charge, the experiment includes a fast-pulse electron accelerator used to help neutralize the orbiter's charge. It is located close to the core electron gun and aligned so beams from both are parallel. The fast-pulse accelerator acts as a current modulator, emitting electron beams in recognizable patterns to stimulate wave activity over a wide range of frequencies. The beams can be pulsed with on/off times on the order of 100 nanoseconds.

So now we all understand how it works, don't we? Phil Denniss may be right about the way it works; I'm blowed if I can make any sense of it.

And that's all for this month, folks. I hope you'll join me again next time. ❖

Icom's GP-22

Continued from page 27

do seem rather short for a unit that is promoted for use by hikers and bushwalkers, but of course you wouldn't normally have the GP-22 running continuously; in most cases you'd only fire it up for five or ten minutes at a time, to get a new fix. If you use the alkaline battery pack, you could also keep a pack of fresh cells in your backpack, for standby use.

Trying it out

Icom Australia very kindly sent us a sample GP-22 to try out for a few days. We found it easier to use than we expected — you really don't need to know much about navigation or the GPS system, in order to get your position fix and altitude.

All you have to do, in fact, is set the GP-22 down on a flat surface in the open (where its antenna has a reasonably clear view of the sky), press a couple of buttons and wait a few minutes. When it has locked on to a sufficient number of GPS satellites the GP-22 gives a few little beeps, and displays the latitude/longitude information. If you also want the altitude, you simply press another button and this is found for you as well.

Doing this just outside our office building in Alexandria, we found that we're located at 33° 55.09' South, and 151° 11.41' East. Our altitude seemed to be 193m above sea level, although we suspect this reading may have been in error because we probably hadn't programmed in the correct 'datum number' for our region.

We didn't have the opportunity to take the GP-22 on any bushwalks or boat trips, to try out its navigational features, and in any case we're not experienced in navigation or map reading. However running through the GP-22 user manual and trying out some of the menu functions suggested that if you are reasonably familiar with the concepts involved, it would be quite easy to drive.

Our impression, then, is that the Icom GP-22 would be an excellent choice for anyone who needs the positioning and navigational features of the GPS system, in a really compact package. As you might expect, this kind of leading-edge technology doesn't come cheaply. The recommended retail price of the GP-22 is currently $1656, tax exempt.

Further information on the GP-22 is available from Icom Australia, 7 Duke Street, Windsor 3181; phone (03) 529 7582, or fax (03) 529 8485. ❖

When I Think Back...

by Neville Williams

Murray Stevenson - 3: From radio broadcasting to responsibility for a complete TV station

Having 'grown up' with Radio 2UE from its humble beginnings to a leading Sydney broadcaster, Murray Stevenson was quite suddenly faced with the responsibility of co-ordinating the technology for a major, new television station. It was a task which he discharged with distinction — responsible in part for earning him an OBE award for 'service to engineering, particularly in the field of radio, film and television'.

1955 was a notable year for Radio 2UE — its 30th birthday, celebrated with a 24-page supplement in *B&T* magazine. Perhaps the publicity had something to do with the fact that Station Manager J.E. Ridley had been overseas looking at television — now only two years away in Australia — and its profound impact on sound broadcasting.

From a virtual 'hobby rig' in a suburban lounge room, 2UE had expanded into two studio/office complexes at separate city addresses, with a full-scale transmitter on the river flats near Concord. Plans were in hand, moreover, to erect a new antenna of nearly twice the existing height at nearby Homebush, and to increase transmitter power to the regulatory limit of 5kW.

Overall, 2UE boasted a Board of Directors with C.V. Stevenson (in retire-

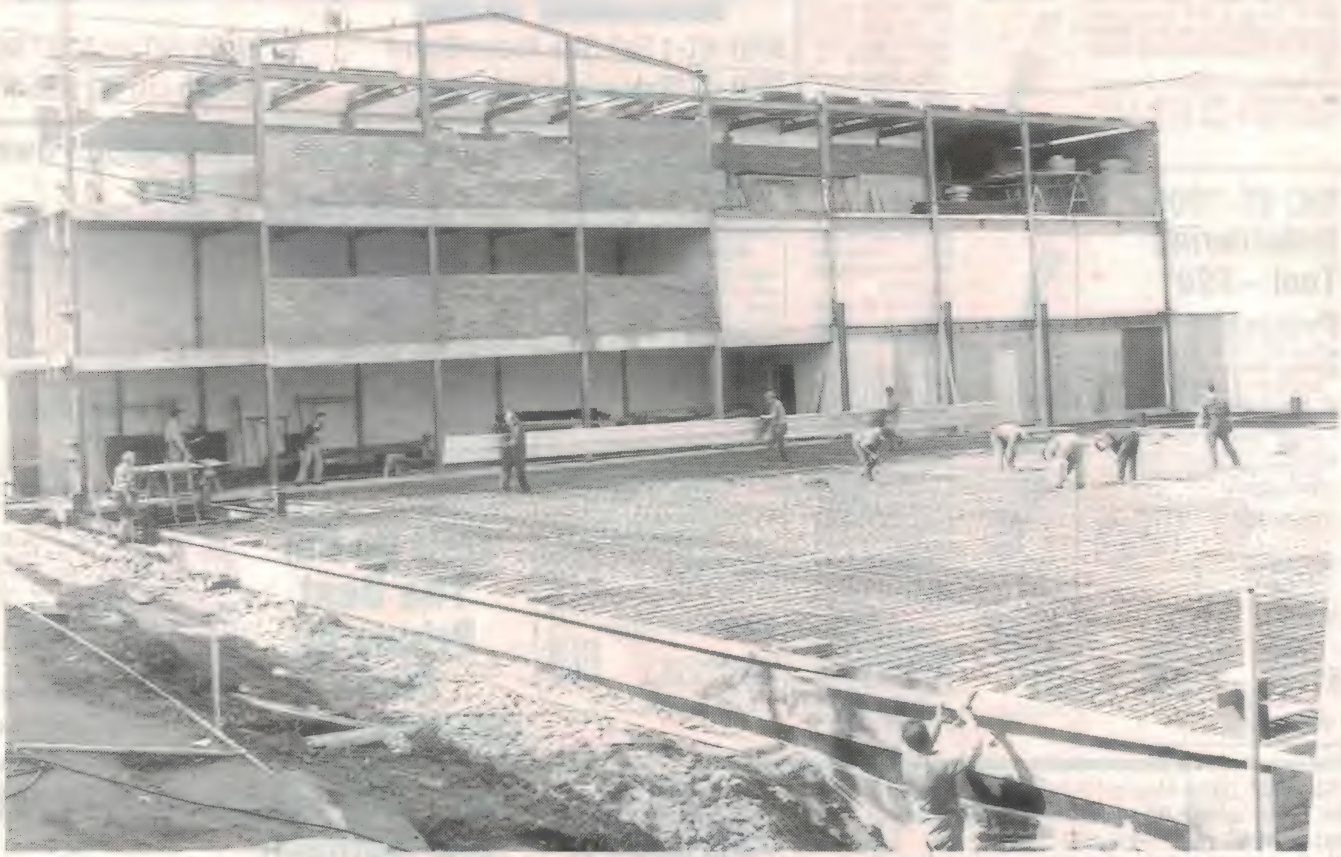


Fig.1: ATN opened with only one functional production area — Studio-B. Studio-A, pictured here, was added during The scale of the project is evident from the size of the workmen on the job.

ment) as Deputy Chairman, and a full-time staff of 130 people.

Once a lone broadcaster, it had become the 'key' station of the 'Major' broadcasting network with 17 affiliated stations spread nationwide. Back in 1925, studio resources had amounted to a microphone, a wind-up gramophone and a handful of 78rpm discs. In 1955, they included 70 assorted microphones, a library of 32,000 78rpm discs and over 1000 of the then-new microgroove pressings.

In the studio complexes were facilities to record top quality discs and tapes, with high-speed tape dubbing facilities to ensure rapid despatch of programs to affiliated stations. The studios were also available to independent agencies, along with a special production team which could conceive, compose amd produce 'singing commercials' to order. A notable member of the team was Des Tanner, an accomplished performer on piano, violin — and later, the Hammond organ.

In terms of entertainment, 2UE and the Major network was 'home' for a dozen or more top-line radio stars of the day, including Bob Dyer, Dick Fair, Howard Craven, Smoky Dawson, Franquin and sports broadcasters Ken Howard and Cyril Angles.

This had been Murray Stevenson's world — not on air, but behind the scenes, where he had to make sure that station equipment remained functional, for around 17-1/2 hours a day, to the satisfaction of a 17-station network. This was even when a fire had gutted 2UE's Savoy House (Bligh St) Studios in 1943, presumably after a current of air carried live cigarette ash into a lint-laden ventilation duct.

Summoned out of bed in the wee small hours, Murray and his staff had to contrive to get a signal to the transmitter for the breakfast session. They managed to keep the station on air, after many offers of assistance — not the least being one from 2CH, to make a studio available until further notice. But, for Murray Stevenson, all this was to change abruptly in 1954/55.

Television for Sydney

Some of what follows I recall myself because, as an employee of the John Fairfax group — then publishers of this magazine — I happened to be in the right place at the right time. For other details I am indebted to Gavin Souter's book *Company of Heralds* (1981), a 150-year history of the John Fairfax enterprise.

Around 1953, Associated Newspapers, which by then held a majority shareholding in 2UE, fell on hard times and merged with the John Fairfax organisation. They, in turn, already held an interest in Radio 2GB and its associated 'Macquarie' network.

About that same time, there was talk of commercial television being authorised by the Federal Government, with reports that Packer's Consolidated Press would be a certain applicant for a Sydney licence.

Cautious, but anxious not to be outmanoeuvred, Fairfax organised a consortium comprising Fairfax/2GB, Associated Newspapers/2UE, Radio 2UW, AWA and Email. Registered as Associated Television Services, they were ultimately granted one of the Sydney licences (ATN-7) — the other going to the Packer group (TCN-9).

Gavin Souter details a lot share shuffling within the ATN group, occasioned partly by concern about a foreign component in some participants' share registers and a Fairfax holding that might be deemed to exceed 50%. Souter says that this latter unease was dispelled when Fairfax General Manager Angus McLachlan raised the matter with the then Prime Minister. Mr Menzies is quoted as having replied: "Mac, if you're fools enough to put more money into television, who are we to stop you?"

As it turned out, the Fairfax group did emerge with a majority interest in ATN, with Managing Director Rupert A.G. Henderson virtually 'calling the shots'. According to Murray, Henderson's experience was limited to the print media — "but he seemed quite fascinated by show business!"

Casting around for a technically informed right-hand man, he remembered A.W. ('Tony') Whitlock, who had supervised the Company's investment in a fleet of reporters' cars equipped with AWA-based two-way radio. Whitlock was currently in charge of the Fairfax London office.

Huge challenge

Whitlock was bidden to drop everything and return to Sydney immediately, to help get the ATN project under way!

"What about my home and family?"

"We'll look after them. You just get here as soon as you can!"

So it was that Tony Whitlock reported to R.A.G. Henderson, subsequently finding his way down a couple of flights of

Fig.2: As viewed from floor level, this studio with 'Stevenson' acoustic treatment was originally fitted out for large scale productions using E-Cam technology. Now designated Studio C, it houses mainly permanent sets, as for the Seven News, etc.

stairs to the *R&H* office in the same building. It wasn't that John Moyle and I figured in the scheme of things; simply that, as a long-time reader of *R&H*, Tony felt that we'd understand the situation well enough to share his concerns about what the assignment involved.

However, when Whitlock did take it upon himself to make executive decisions, Henderson tended to question his judgment; and after about 10 weeks, the appointment was terminated. Tony was sent back to the London Office, and his family's transfer to Australia reversed in mid voyage!

Tony Whitlock was duly replaced in the scheme of things by C.G. Alexander, a TV station manager from the NBC network (USA). But that didn't work out either and Alexander was succeeded, in turn, by James Oswin. Until then Manager of Macquarie's Melbourne radio station 3AW, Oswin proved equally successful as General Manager of ATN.

Meanwhile, decisions about siting and equipment had been entrusted to an expert technical committee, originally set up by Tony Whitlock. It comprised the chief engineers of associated radio stations 2GB, Len Schultz; 2UE, Murray Stevenson; 2UW, Tom McNeill; and one of my own long-time friends from AWA, (the late) Dr Ernest Benson.

All of these men had existing committments, however, and an essentially 'spare-time' committee proved a cumbersome way of getting things done. Clearly, ATN also needed a full-time technical manager — in short, a chief engineer.

At this point in time, Murray Stevenson's earlier diversion into film and studio technology gave him an edge in the world of TV broadcasting. With the concurrence of 2UE management, he was invited by R.A.G. Henderson to become full-time Chief Engineer of ATN-7, with the prime responsibility of getting the station to air.

With the PMG having set down basic ground rules for the transmitters, it was no great hassle for Murray to co-ordinate the purchase of property and the contracts for the provision of a suitable tower, antenna and transmitter at Gore Hill, adjacent to the ABC's ABN-2 installation.

(Later, when the ABCB increased the permissible height of TV towers in the mid 1960's, ATN agreed to contribute to the cost of a tower being erected in nearby Artarmon by the new Channel TEN-10, supporting a shared antenna array 1000ft or 305m above mean sea level).

Provision of the initial transmitting facilities was essentially an engineering exercise. However the siting and planning of an ambitious studio and administration complex — the public image of the station — was something else!

It did have its funny side, however, as recounted by Murray some years ago.

Wanted: a site

Having successfully effected the transfer of John Fairfax and Associated Newspapers from their respective inner city premises to the present address in Jones St, off Broadway, R.A.G. Henderson was 'all steamed up' about the need to find an appropriate site for the ATN studio complex. It had to be elevated; accessible from the city; spacious enough for multiple studios with technical facilities, offices and a reception area to cope with studio audiences, amenities for staff and visiting performers, landscaping and parking areas, and a microwave tower with line-of-sight access, especially to Gore Hill. All this, and room for future expansion.

The problem was that neither the original expert committee nor Henderson's request to Fairfax management personnel to act as discrete 'spotters' had come up with a suitable site. So in sheer exasperation, Henderson headed off in his car to spy out the land for himself.

It took a while, but in due course, Murray received a phone call to arrange a time and place for him to be picked up to inspect a likely looking semi-rural site, compromising 20 acres or more. So it was that he found himself in a chauffer-driven car with an independent property consultant and the Managing Director — the latter replete with black suit and Homburg hat — heading in the general direction of Epping on the City's north-west fringe.

Approaching their destination, R.A.G.H. stressed that no one was to mention Fairfax or — especially — why they were interested in the property. "Sure as we do, they'll gazzump the price!"

After further cogitation, Henderson asked the driver to pull over and change places. He didn't want to be identified as an executive, he said; he'd simply be the driver. Murray would look the place over and do the talking — but he'd be listening!

"Fair enough", said the consultant, "but if you don't want to look conspicuous, you'd better discard your Homburg hat, as well"!

Fortunately, the site proved eminently suitable and now accommodates considerably expanded production facilities, a station heliport and a free-standing signal tower which is often floodlit on festive occasions. On our first visit, in the 1950's, John Moyle and I christened it by climbing aloft for a look around the countryside.

Building a TV station

To start from bare ground proved an enormous advantage to Murray Stevenson. Recalling what he had seen on his tours and read about in technical journals, he could begin with a blank pad and develop possible layouts for on-

Fig.3: An early photo of the ATN studio/administration complex, with studios A and B on either side of the tower. Additional facilities now occupy most of the open space, with Studio C and its associated technical support to the right.

going discussion within the management group and for architects to refine.

It was a very different story for some other aspiring TV broadcasters, who opted for a factory site or an already developed slice of suburbia. Faced with the need to demolish some buildings and build into or onto or around others, it could add up a messy operation with the end result still looking distinctly contrived.

It's a long time ago, but on a couple of occasions when John Moyle and I visited the embryo station at Murray's invitation, there was a sense of purpose about the ATN project — uncluttered passageways giving access to the various areas; studios and production booths isolated from work-a-day noise; technical and support facilities where they belonged, accessible under-floor cable runs and so on.

According to Gavin Souter in *Company of Heralds*, Murray Stevenson initiated most of the design, as necessary to get the station to air by December 2, 1956. Jim Oswin, he says, contributed later in his role as general manager, mainly in relation to subsequent expansion.

("As I recall", says Murray, "the start-up project came in at £30,000 — or $60,000 — under budget!")

Some years later, I had occasion to visit a couple of the then- new Brisbane TV stations, partly out of curiosity and partly as a social call on a Musical Director, Wilbur Kentwell (an old school mate) and one of the Chief Engineers, Ross Thyer, who I had met in the early days of ATN-7.

QTQ-9, as I recall, was a less ambitious complex than ATN but it had a similar layout and the same purposeful look. Mind you, that was more than 30 years ago and the 'Stevenson stamp' (my term) may now be less evident than once it was.

Curiously, 30 years later the present production staff at ATN remember Murray less for his pioneering efforts than for the convention he encouraged: that, on the job, ATN technical personnel should wear spic-and-span white overalls, preferably with a tie!

Sound-film technology

In those early days, television signals had to be sourced either direct from TV cameras or from scanners capturing the image and soundtrack from suitably synchronised motion picture sound films. For ease of handling and reduced cost, TV stations normally specified 16mm prints, although some had back-up 35mm facilities to cope with special situations.

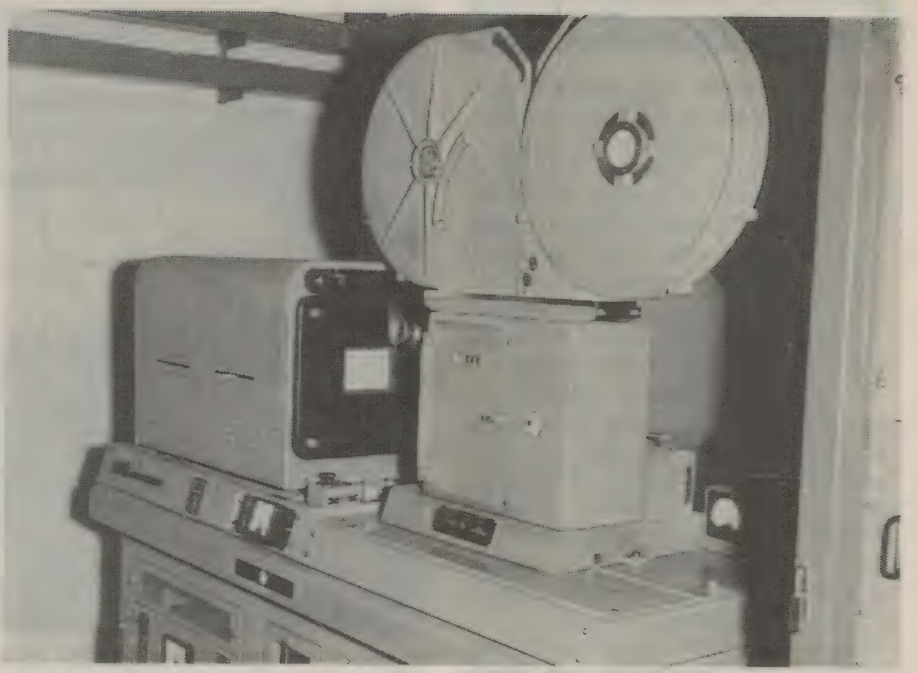


Fig.4: Before the introduction of video tape technology in the late 1950's, video recording involved capturing the image and sound from a high definition source on 16mm sound film, using a camera synchronised to the 25-per second TV frame rate.

Of necessity, everyday news gathering involved the use of portable 16mm sound cameras, the film having to be processed and edited in the studio to prepare it for TV presentation.

In-studio video recording also depended on 16mm film technology, with the televised image being captured by a sound-film camera, so synchronised that the camera's inter-frame pull-down would coincide with a TV flyback interval.

A fortunate aspect of the European/Australian TV standards was/is that synchronisation can be achieved by a slight increase in film frame rate from 24 to 25 frames per second — the resultant 4% increase in the rate of movement or sound pitch being of little consequence.

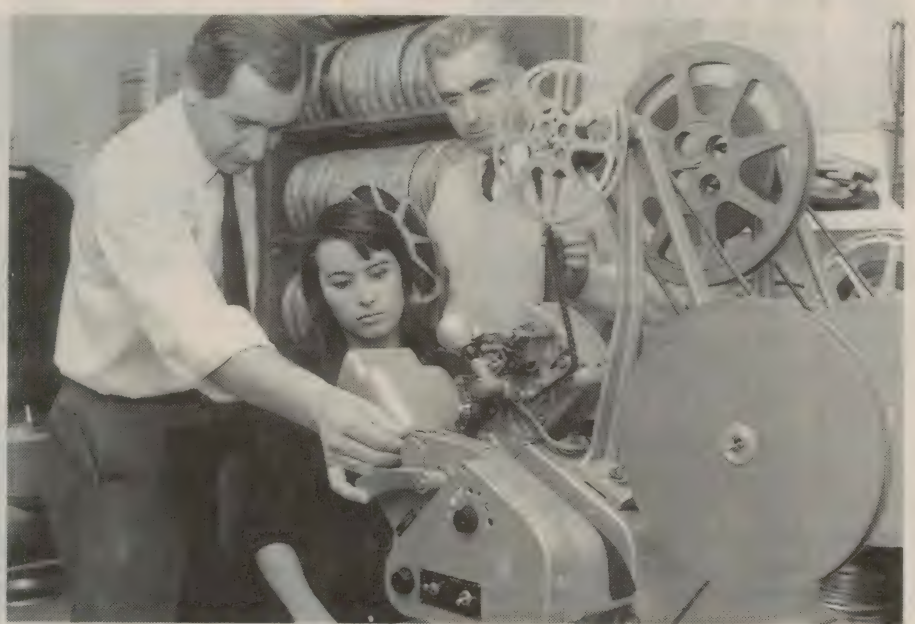


Fig.5: Technical facilities at ATN in the early days were dominated — visually at least — by the profusion of 16mm sound film equipment. Pictured here is one of the early film editing desks.

An impression that remains from those early visits to ATN was the array of sound-film gadgetry — cameras, scanners, editing facilities, reels, racks and so on. But dominating everything else was the continuous film processor, where exposed film from light-proof camera magazines was fed in one end, developed, tone reversed from negative to positive, fixed, washed, dried and finally spooled up ready for editing.

Looking back, Murray recalled how exposed news film had to be available for processing not less than one hour before the evening bulletin. It would be spliced on to film already threaded through the processor, and sent on its way. Twenty minutes later it would emerge dry from the far end, ready for delivery to the editing consoles.

There it would be checked, cut, spliced, cued, re-spooled and finally loaded into a remotely controlled scanner so that the producer could interleave filmed scenes with live studio shots of the newsreader.

It sounds cumbersome, and so it was; but the procedure was routine to a professional member of the SMPTE. At the time, Murray said, it served the purpose in a way that reflected credit both on the equipment and the production staff.

Oh, for a better way!

In this context, it is interesting to mention an excerpt from this magazine (then *Radio & Hobbies*) for February 1952, page 23. It tells how David Sarnoff, Chairman of RCA (Radio Corporation of America) was celebrating his 45th year in radio.

Looking ahead, Sarnoff said that by his 50th anniversary, five years on, he would like to see RCA achieve three new breakthroughs in electronic technology: (1) An electronic light amplifier; (2) a non-photographic method of video recording; and (3) An electronic air conditioner with no moving parts. Here I quote from the original article:

"The second is a television picture recorder which would allow television programs to be recorded and reproduced just as sound programs are now recorded on discs or tape and reproduced on gramophones".

"The present system of film television is too costly, time consuming and limited. But the new television recorder would be just as simple as a gramophone record and just as flexible in its use".

Fig.6: Reminiscent of a theatre organ, Strand lighting control consoles like this were used for many years in studios A and B. Installation and operation called for a high level of expertise.

(An editorial addenda to the above says: Zworykin, also of RCA, made reference to this possibility several times, when in Australia recently).

In 1952, the prospect of recording video information on either disc or tape seemed forlorn indeed. At practical disc or tape speeds, the wavelength of even high audio frequencies was already so short that it was nudging the resolution limits of styli and tape heads alike.

To achieve a response to several megahertz, for video signals, would seemingly call for an impractical improvement in stylus or head resolution, or an impractical increase in tracking speed, or both.

Despite this, video tape recording was achieved well within Sarnoff's suggested time frame — but not by RCA. It also happened at just the right moment for ATN.

Birth of video tape

As Murray Stevenson tells it, he had decided that ATN must equip with an in-

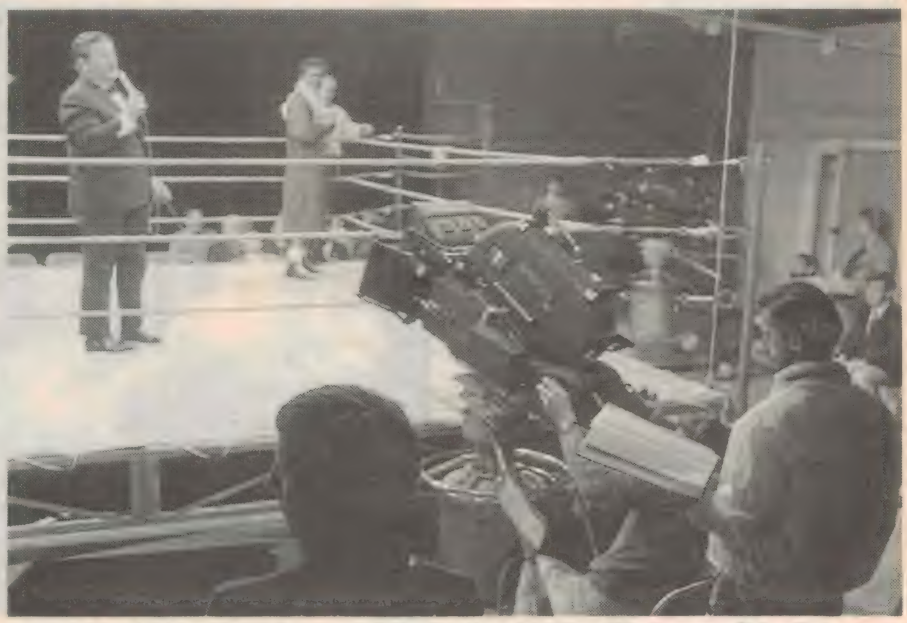


Fig.7: Ready for an episode of 'The Battlers' in Studio C, as originally set up. Note the Arriflex camera in the foreground able to capture on film an exact duplicate of video images actually selection for transmission.

itial two Marconi cine recorders. Having entered the TV field, and urged on by Jim Oswin, the Fairfax group had accepted that they might as well go the whole way and become a supplier of locally-made programs and advertisements to other stations — per medium of 16mm film.

The order was about to be confirmed when (the late) Graham Hall of Plessey, a keen IRE member and amateur radio station operator, told Murray of a conversation with an American contact during the previous evening. Ampex, he said, had stolen a march at a current industry convention by demonstrating a practical video tape recorder, using a 2" (50mm) tape travelling at a manageable speed.

Intrigued, but not necessarily convinced, Murray did his best to confirm the report, recommending to R.A.G. Henderson that, for the present, they should order only one cine recorder and keep the rest of the money on hand for possible tape equipment.

Henderson duly cabled the New York Fairfax office, to seek verification from Ampex, and received an assurance that it was no rumour; the recorder had indeed performed well, and they were going into limited production. The tape speed was the same as the highest audio speed (30ips) but the writing speed was much higher because the tape was traversed laterally by spinning heads.

In direct contact with Ampex, Murray ascertained that limited production meant six or at most 12 units, all spoken for and all for the American 525-line, 60-field standard.

Yes, Ampex *would* ultimately be producing a 625-line 50-field version, but not for the present. When the time came, they planned to develop the Euorpean version in Frankfurt.

Said Murray: "That will take years!"

He finally managed to talk them into shipping a 525-line unit to ATN at the first available opportunity, accompanied by one of their engineers. ATN would provide the resources necessary to convert it on the spot to local standards. ATN would get their video tape recorder and Ampex would get their money plus the design modifications — along with hands-on experience in a 625-line TV production environment.

In due course, the recorder arrived, along with Ampex engineer Kurt MacHine. "Believe it or not", said Murray, "MacHine had it going on our standards in just three days!"

As well as their machine, ATN had gained the distinction of being involved in the development and installation of the world's first ever 625-line 50-field video tape recorder.

Fundamental facility

Since then, video tape has become a fundamental facility to all TV stations and networks for recording, assembling, editing, storing, replaying and distributing TV programs. The basic Ampex system of scanning with spinning heads is still widely used, but has been extensively refined to provide more production facilities and better results from less cumbersome and less expensive hardware.

An article in the March 1993 issue of *EA* tells how the adoption of digital rather than analog signal processing has now virtually eliminated the one-time problem of both film and tape — the progressive loss of picture and sound quality with repeated 'dubbing' or copying.

It is no less startling to realise that — 40 years after even B&W video tape recording was deemed 'impossible' — most television viewers in Australia routinely record, rent, buy, swap and replay colour video recordings on cassettes costing only a few dollars each.

While getting ATN-7 to air was a herculean task for Murray Stevenson, the job didn't end there. He and his technical team had to learn the practicalities of everyday video tape recording, as the medium was gradually substituted for film technology.

What's more, as ATN emerged as a key station of the 7-Network, the technology had to be promoted and shared with associated stations around Australia. Again, when ATN/Fairfax absorbed the Artransa film studios, they had to be co-sited and their respective technologies merged.

Out of this came 'E-Cam', involving 'Arriflex' video/film cameras with split sound and optics such that producers could easily and economically monitor scenes and rehearsals as viewed on a TV screen.

For the final 'take', they could activate the cameras' in-built photographic facility, confident that they would capture on 35mm film the precise images from each camera, as selected for transmission by the video mixer.

Automatically cued at each start/stop point, the film takes could be assembled to provide a high quality 35mm master, for duplication, and/or to produce 16mm reduction prints for distribution to TV stations. For this latter purpose ATN/Artransa installed a special facility.

Obedient to the calendar, Murray retired in 1970 at age 65 — but not before he had briefed ATN management on the implications and likely cost of converting to colour transmission in the not-too-distant future. Also in view was the possibility of adopting teletext and, ultimately, stereo sound. Years later, these innovations were to be installed by an engineering team which followed in his footsteps — along with ATN's world- first 'Race-Cam' technology, developed by one of Murray's successors, Geoffrey Healy.

But retirement for Murray didn't mean cutting adrift from the industry. He continued his association with the IRE (Aust) and, as well, accepted the position of part-time Engineering Consultant and, later, Secretary of the Engineering Committee of FACTS (Federation of Australian Commercial Television Stations).

It was a position he held until June 1984 — a uniquely informed and eloquent spokesperson for the industry.

When I mentioned his OBE, conferred in 1984, Murray made somewhat light of it:

"You've heard what those letters stand for?"

"Order of the British Empire? Okay — I give up!"

"It's been said that OBE is the recognition you get for Other Blokes ' Efforts!"

To me, this was Murray's characteristic acknowledgement that as team leader at 2UE and ATN, in the IRE, the SMPTE and FACTS, he owed a great deal to fellow engineers and technicians who had helped him on his way up a very long engineering ladder!

(FOOTNOTE: The copyright photographs used in this instalment were made available on a 'single use only' basis by ATN Channel 7, Sydney.) ❖

The height of achievement!

During the preparation of this article, I came across Alan Mewton, who had worked with Murray as foreman electrician during the construction of ATN.

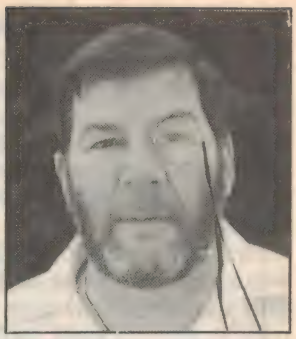
Alan recalls that, as he and a mate were eating their lunch on the job on Christmas Eve 1956, Murray and his wife walked past. After exchanging Christmas greetings, Murray added:

"The way you two chaps are working, you'll rise to great heights in this industry!"

Said Alan: "In later years, my mate and I often reminded each other of Murray's observation when we were perched precariously up under the studio ceiling tending the lights!"

Moffat's Madhouse...

by TOM MOFFAT



Telemarketing: Tell 'em to cark it!

Bluster alert! Bluster alert! Tom's going to get on his high horse again, and rant and rave about yet another social injustice. Another new and vile lifeform, brought to us by an amalgam of the highest technology, business greed and the humble telephone. It's called 'Telemarketing' by polite people, and junk phone calls by those not so polite. We have suffered junk mail, and then junk faxes, and now junk phone calls. Is there no peace?

Up until a couple of weeks ago I'd never been the serious target of telemarketing; just the occasional call from someone rattling the tin for some charity.

You know the kind of stuff; buy these fine greeting cards and help the Victims of Chronic Runny Noses. If the charity seems worthwhile, and most are, you then agree to buy whatever is being flogged. You suspect that you are paying an enormous price for them, but the goods are only a token; what you're *really* doing is making a donation.

But in the past couple of weeks, I've had my life enlivened by three junk phone calls, not from charities but from organizations intent on talking me into handing over some money to swell their own coffers. The first of these was from Tasmania's own Hydro-Electric Commission, the official government-run power authority.

The lady on the phone began: "Is that Mr Mowrfaht?" At least they could make an attempt to get your name right, because from then on it is used in every sentence.

"Mr Mowrfaht, are you aware of the Hydro's Tariff 41?" No, nor am I aware of the Hydro's Tariff 16, or 31, or 8-1/2 for that matter.

"Well, Mr Mowrfhat, with our Tariff 41 you can now afford to heat your home with electricity. What kind of home heating do you use now?" Wood.

"Mr Mowrfhat, you can throw that old wood heater away and replace it with clean, efficient electricity. Would you like a representative to call and show you how you can heat your home with electricity, Mr Mowrfhat?" No, no, please!

"Well, Mr Mowrfhat, would you let us send you a brochure fully explaining Tariff 41?" To that question I said OK, just to get rid of the saleslady so I could get back to work.

The very next day the brochure appeared in my letterbox. Why is it that government mail seems to appear instantly, while private mail takes two days? But that's another matter. I dutifully browsed through the brochure, thinking that maybe the Tariff 41 could jazz up the somewhat meagre heating in our beach shack. I was really quite happy to stick with wood heating at home, as are more than half of all homeowners in Tasmania.

As I studied the brochure, I discovered that the cheap rate did not apply for electric heaters under something like 3.6kW. Now the beach shack is only seven squares, and a 3.6 kilowatt heater in an area of that size would turn the place into a sauna. As well, use of Tariff 41 would require the installation of a second electric meter, and the hot water heater would have to be hard-wired into the new circuit instead of simply plugged into a wall socket as it is now. A big, expensive job for an electrician. So much for Tariff 41; the Hydro's brochure took a flying leap into the rubbish bin and that was the end of the matter.

A couple of days later it happened again. I had my head buried deep in a computer, fighting with a reluctant screw, trying to install a bracket that held a couple of accessory cards in place. I just about had it when... RING-RING! I had the option of ignoring the phone, or dropping the bracket job to start from scratch later. Since the phone call was most likely something to do with my kit business, I released the screwdriver and picked up the phone.

"Is that Mr Moffat?" Oh-oh — that had a familiar ring to it. At least she got the name right this time. But it wasn't the same lady.

"Mr Moffat, I'm calling from Queensland to offer you the chance to win a million dollars in our lottery. Mr Moffat (name in every sentence, remember), you could join your neighbour Mrs Jones of Lenah Valley as a big winner in our million dollar draw. Would YOU like to be a millionaire, Mr Moffat?"

Well, there were a couple of things wrong here. Mrs Jones certainly wasn't a neighbour, because Lenah Valley is about four suburbs away from here. And if Mrs Jones HAD won her million dollars, I'm sure there would have been something about it in the paper. More likely she won $10, leaving the $999,990 to someone else in the 'million dollar draw'.

Come to think of it, I'd heard that spiel before, or rather read it. *Dear (fill in the blank here), This is to inform you that you are now eligible to win two new cars, a boat, an airplane, a new house, and a holiday home on the French Riviera. You can join your neighbour, Mr (fill in the blank) of (fill in the blank) who has just won the British crown jewels. All you have to do, Mr (fill in the blank) is return this gold key...*

Does that sound familiar? We've all received such 'good fortune' from time to time. A computer fills in the blanks so you think you've got a personal letter, but most times the (fill in the blanks) are printed a bit wonky compared with the rest of the letter, or in a darker ink.

Contemplate this latest offering from Readers Digest, which arrived for my wife yesterday: It turns out that she is registered entrant number 2260/93, of ranking: PRIVILEGED. The next page says 'NOTICE: Your name, Mrs (fill in the blank), was selected by our computer as being among those people who have not yet seen our best-selling gardening encyclopedia. As we think the book will be of enormous help around the garden at your (fill in the blank) home, we urge you to send for a copy'. Now if the computer puts MOFFAT in the first blank, and FERN TREE in the second, you've got your personalised letter. This time not just the names, but the whole lines containing the names, were in darker ink.

Let us now turn the page again. 'The

name, Mrs Moffat, has appeared several times in our computer tabulations. First, when a selection for Sweepstakes entry was made and then when tickets were computer-registered to... M R S W T M O F F A T'.

It appears the computer in question, as well as writing the (fill in the blanks) in darker print, must also write names with extra spaces between each letter when preparing to hand out a sweepstakes prize. Ah, the wonders of modern technology.

RING-RING! There goes the telephone again. "Is that Mr Mowrfaht?" Hey, it's the lady from the Hydro-Electric Commission, having another crack at me!

"Have you received our brochure on Tariff 41 yet, Mr. Mowrfaht?" Yes I had, but then I went on to tell her that the Hydro's 3.6kW minimum heater size would surely set my little beach shack on fire and melt all the occupants within it. I also expressed my concern about all those expensive modifications to the electrical system in order to qualify for Tariff 41. Despite the fact that my case must have looked a hopeless dud by then, the lady persevered:

"Would you like us to have a representative call and assess your electrical requirements, Mr Mowrfaht?" I pointed out that the house in question was more than 70km from the city, but no worry, a representative would be glad to call. All right, suit yourself, I said. Perhaps the matter of heater size limits is negotiable. Maybe the Hydro will do the wiring changes for me, for free. (Maybe they won't speak to me after reading this article, too...)

This whole telemarketing business raises some interesting questions. Wouldn't it be frightfully expensive, making all those phone calls? Unless they've done some kind of package deal with Telecom. What about all those calls from Queensland? Would it be worthwhile making a trunk call to every home in Tasmania in the hope of flogging a few lottery tickets?

With the arrival of Optus, and its competition with Telecom, a lot of changes are taking place in our telecommunications system, most of them for the better. But do you think one, or both, of the companies is now offering a special 'telemarketing' package? In the Queensland case, maybe a 008 number in reverse, so the calls go out instead of in.

When I worked for the Bell Company in the USA, we had things called WATS lines (for Wide Area Telephone Service), that allowed, say, a company in New York to have a local phone number in Denver. Anyone in Denver could ring the number as a local call, and the people on the end of the line in New York could phone any Denver numbers as local calls. This service wasn't cheap, but it was better than copping a trunk call each time, and it was cheaper than having a branch office in Denver.

Has Telecom or Optus started supplying WATS lines? If so, that Queensland lottery mob could hire one into Tasmania for three months or so and then saturate the place with junk phone calls, all for the one fixed price. After that they could terminate the Tasmanian line and move on into Victoria or somewhere.

A couple of years ago, I was forced to make my own moral decision on telemarketing. I was doing some work for a company making gadgets that allowed a business telephone to read commercials at you when you were put on hold. I didn't much admire this contraption, but they wanted to produce a fully solid-state version that would play a recorded message from digitised memory instead of a tape. Greedy me, I saw a way to make a buck in it. But then they came up with a follow-on idea — a thing that would ring up selected phone numbers and blabber off a digitised sales pitch when the phone was answered. In other words, fully automated telemarketing.

I could see that, technically, this would be no problem. But I told the guy NO! I didn't want any part of it. How would HE feel if some computer wrecked his evening by phoning him up to sell lottery tickets? After a lot of persuasion I managed to swing the fellow around to my way of thinking, and the automatic telemarketing machine died a welcome death.

That might have given Australia a reprieve for the time being, but I think it's dead certain that somebody will eventually inflict upon us a machine that will produce junk phone calls in wholesale quantities without any human effort at all. Come to think of it, considering that the lady from the Hydro couldn't get 'Mowrfaht' right after so many tries, maybe she was just a computer herself, filling in the blanks with a badly programmed speech synthesizer.

Have you heard of the Anti-Football League, championed by people like Keith Dunstan and Tim Bowden? Well, maybe we should start an 'Anti Junk Phone Call League' to campaign against this insidious menace. Junk mail is easy; you just chuck it in the bin. However, most people are of a decent nature; they would be loath to hang up on a junk phone call for fear of offending the caller. But can you insult a computer? ❖

THE SERVICEMAN

The VCR which almost took me to court, and a new use for a hot glue gun!

This month we again have stories both from contributors and from my own bench. It's a varied batch of yarns, so settle down and enjoy. I'm going to start with a cautionary tale from my own bailiwick, about a written-off VCR which nearly landed me in court — as a witness, I hasten to add.

If you're anything like me, you can get into serious trouble without ever lifting a finger. Just now I'm involved in a court case that has nothing whatsoever to do with me.

A week or so before Christmas, a man in a blue uniform hammered on my door and demanded to see me. When I presented myself at the portal, he handed me a slip of blue paper and said "Be there!"

The blue paper said, among other things, that *We command you and every of you all business laid aside and all excuses whatsoever ceasing you and every of you be and appear before the Supreme Court at its session of Oyer and Terminer and General Gaol Delivery in and for the State of etc. etc...*

After another half page of similar archaic language, it turned out that I had to be a Crown witness in a criminal trial at the Supreme Court. No further information was given, and it was left to me to work out what I was supposed to be witness to.

The policeman who delivered the subpoena had no real idea of why I was called, but he did venture the information that he thought it was a matter of burglary. This reminded me of a job I had done some months earlier, but at that stage the connection was tenuous, to say the least.

The job in question was an Akai video recorder that has been brought to me for service, after it had been recovered following a burglary at the customer's home.

It appears that the video had been stolen along with a lot of other goods, but as it had the owner's name prominently engraved into the front panel, it had no value to the thieves and they had dumped it over the fence into a neighbour's garden.

After the neighbour had returned the machine, the owner tried it out but it wouldn't work. There was no outward sign of physical damage, but quite obviously the rough handling it had received had done something very nasty to the works inside.

I had spent several hours trying to determine what was wrong with the machine. I could get some functions to operate properly, but not all functions together. It might play and rewind, but not fast forward and eject. Or it could be made to rewind and eject, but not play or forward search.

After spending as much time on the job as I could afford, I told the owner it looked as though the chassis had been distorted so as to prevent any hope of restoring the full range of normal mechanical operations. The machine was six or seven years old, so it looked to me like a write off.

His insurance company agreed with the decision and eventually paid out his claim. This left the machine as junk and by mutual agreement it finished up in my workshop. Although the mechanicals could not be made to work, the video heads and all the electronics were still OK and might eventually compensate me for the time I had spent trying to fix it.

The machine sat under the bench for several weeks. Then one day a dapper young man in a dark suit and narrow brimmed hat appeared in the doorway. He introduced himself as Detective Sergent So-and-so from the local CID office, and asked if I still had the video once owned by —— (he mentioned the name of my customer).

I admitted that the machine was still under the bench, and asked about his interest in a dud video. His interest, it turns out, was as evidence in a court case. It seems that the police had caught a couple of villians and had a good chance of getting convictions in respect to my customer's burglary. All they needed was some evidence — from my junk pile.

So that was the last I saw of the dud Akai. The detective took the wreck away with him and I was left hoping that I wouldn't need any of the parts from it before I saw it again.

Then when the policeman appeared at my door with the subpoena to attend court '...in the matter of a crime...' I put two and two together and assumed that I was going to be asked about that particular Akai.

At the time of writing the case has yet to come up, although I did see where the villains have been remanded to appear later in the sittings. So I still don't know what I am going to have to testify to.

The whole experience up to now has been more annoying than inconvenient. I have lost the few hours spent on the Akai in the beginning, but I might recover that time if I ever get the machine back. Then I lost an hour talking to the detective — but I could have spent just as much time talking to a customer.

I'm told that when I attend court, I can claim no more than $60 a day, and then

only with all kinds of documentary evidence that I have actually lost the money. I don't look forward to that experience, since I don't have a 'Wages Clerk' or an 'Accountant' to issue the appropriate certificate. It looks as though I'll just have to write the court time off to 'experience'. (At least, the Tax Office can't demand taxes out of money I don't earn — or can they?)

And now, just as I had finished writing the notes above, word has come to me that I will not have to attend court after all. It seems the villains have pleaded guilty, and all that remains is for them to be sentenced.

I understand that the junked video recorder will be returned to me shortly, so I will probably recover the value of the time I have put into the case. But what of the cost to the community?

The police spent many hours investigating the crime and preparing the evidence. Then the prosecution had to prepare its case and the defendants had their counsel prepare some kind of a defence, even if it was paid for by Legal Aid. There was court time involved when the burglars were remanded, and the cost of that 'General Gaol Delivery' to get them to and from court.

Then I lost time over the matter, as did the victim of the burglary. It would be quite easy to account for $10,000 worth of professional time in a single small case like this.

And all of the goods stolen wouldn't have netted the burglars as much as $1000 — the Akai video was the biggest single item, and they threw that away!

Now they will have to be accommodated at public expense for however long the Judge decides. What a waste of time and effort for all concerned!

Now that it's all over, I've learned a valuable lesson that I am happy to pass on to you. I suggest that if a customer mentions 'burglary' or 'theft' in connection with any job presented over your counter, that you leave it well alone. It could finish up costing you more than you'd ever get from the customer by way of a repair bill.

Man of mature years

Now to this month's contributor. He is B.T. of Wahroonga in NSW. On his own admission, B.T. is a mature age gentleman, and some of his stories confirm that matter. Nevertheless, he is still quite active and the final item in this batch suggests that he still an active and versatile serviceman. See what you think:

The Serviceman is one of my favourite columns in EA. It keeps appearing decade after decade, so I would guess that like me, you have also joined the mature age group society some time ago.

I have always had the intention to contribute some tid-bits from my own store of old chestnuts, but alas it remained just that, another good intention. As the saying goes, the road to Hell is paved with good intentions.

My most valid excuse is the fact that I gave up TV servicing when colour appeared to brighten up our screens. At that time I switched to industrial electronics and although this field can produce some remarkable and spectacular faults, these don't exactly fit the Serviceman's usual columns.

Some of my problems require extensive redesign (e.g., the replacement of germanium transistors). Others can be very rewarding — some would pay more than earned in a full year of fixing black and white TV sets.

For instance, an SOS call from Murray Bridge in SA turned out to be a three week job resurrecting a solid state control system. The cabinet was filled with 134 printed circuit boards, with all logic functions made up of discrete components. The active devices comprised some 4000 PNP and NPN small signal transistors.

The local electrician had got to it before I did. He tested the cabinet using a megger, and it took me three weeks to change some 3500 transistors and about 500 diodes. Two similar units went under water in the 1972 Brisbane floods. One month of solid work was needed to get those working again!

Well, let me go back to the TV scene. My most memorable service call crossed my path on a humid 105-in-the-shade day on the 23rd December, back in the early sixties.

After I had finished servicing a half dozen odd brands in a mental institution, the Director invited me in for a Christmas drink. Those were the good old days, several decades before the fringe benefits tax was invented, and the icy cold amber liquid tasted good on that stifling day.

My next call was to a large 23" Kriesler. When the set warmed up, I was staring at the most unusual screen. My first thought was that I' d had one icy-cold too many! The black screen had one thin vertical line in the centre! The horizontal white line was a routine fault in those days — vertical output transformers used to go open circuit frequently; but a horizontal deflection fault with the full EHT present was just not possible!

I felt like a serviceman in the wrong joke. The chassis was a 79-3. The circuit diagram was fortunately in the van, and it was not hard to fix the fault after the circuit diagram was consulted.

The horizontal deflection coils were fed through a 0.18uF capacitor (C159). This was open circuit. The lady of the house was very pleased to get her set working again before the holidays, and offered me a drink. This time I opted for a lemonade — icy cold of course!

My next story is more recent, but alas it has no relation to a TV fault. It happened just a few weeks ago. A retired couple living across the road called a service organisation to fix their washing machine.

I learned about it through my wife, who is well aware of my aversion to washing machines and allied domestic equipment — but asked me to check the neighbour's machine anyway. They were suspicious of the serviceman's quotation.

Well, truth be known, I did not like the idea one bit. I have to be down to my last shirt in the drawer and have been subjected to a barrage of not so subtle hints before I will touch our own, let alone a neighbour's washing machine — and to be called in as a judge of a service organisation as well! Alas one cannot refuse to help a neighbour.

The service quote was shown to me first. It was an estimate of a motor replacement for $220, and a call fee of $35. The wording of the quote was a bit vague.

The machine turned out to be the most easily serviceable washer I have ever seen. The motor was out of the machine in less than 10 minutes.

And the fault was obvious! It had a wound rotor with commutator. The two brushes were worn down to a length of 6mm, and the spring loaded levers intended to keep the brushes in contact with the commutator were resting on the brush holder only.

Just for a Laugh!

'Fowlers Spare Parts':

The complaint was that the sound from the video recorder was 'warbling', and the picture occasionally showed noise bars.

You'd be correct if you diagnosed the reason as trouble with the capstan motor or its drive circuitry. What you would never anticipate is the real cause of the problem.

It seems that at some time in the past the capstan belt had broken, and the owner cast around for something to replace it with. He decided that the belt was just another rubber band, so he raided the kitchen to find something of the right size and resilience. He grabbed one of his wife's Fowlers preserving bottle sealing rings. It did work, though not very well! (*E.B., Ferntree, Tas.*)

A pair of replacement brushes obtained from Hoover for $5.55 fixed the trouble.

Now I do not like 'serviceman bashing'; stories in the media are so often biased or incorrect. However when an attempt at such a blatant rip-off happens not more than 100 feet from my front door, and the serviceman even provides his own damming evidence, then it ought to be exposed.

The organisation claims on its printed form 'refrigeration and washing machine service'. No doubt the make and model of the machine was ascertained during the initial phone call when the job was booked in.

The serviceman should have had the brushes in his van, or else driven to Hoover to buy a pair as I had to do. Even then he would not have spent more than 1-1/2 hours on the job, including the trip to Meadowbank. I leave it to the readers to draw their own conclusions.

Thanks, B.T. Your reminiscences do strike a chord in my memory, although I can't ever recall having to replace 3500 transistors in a single job!

And I agree with you about the washing machine serviceman. That does appear to be a blatant ripoff. In similar circumstances I would have expected no less than a motor exchange service, if the company did not want to service the motor in the customer's home. It beats me how companies like this can continue to exist. Consumer protection bodies and the relevant laws should really clean them out, but they seem to flourish as much now as they did 20 years ago.

I don't know the answer, other than to advise consumers to choose their serviceman carefully. A promise of cheap repairs can often turn out to be a very high priced ticket indeed!

Use a glue gun!

Now we turn to a contribution from an old friend. At least, he admits to being an 'old' friend — like me he can remember when a new TV cost nearly a year's wages!

He is K.W. from Lane Cove, and his story this month is about trying to resurrect one of those very expensive TV's. This is how he tells it...

The number of discarded colour TV sets that have come my way over the years, needing only minor repairs to get them back into good (sometimes first-class) working order, is really quite appalling. Even when I've had colour TV's coming out of my ears, I've found it hard to resist the temptation to try to breathe some life into these cast-offs, even ones that would probably have been better off left on the roadside! I guess I'm just showing my age — I can remember when these sets were new, and cost a fortune.

Recently a non-electronic workmate brought in a fairly elderly Rank he'd found on the footpath. (The model identification had long since fallen off, so I can't say what chassis it was). The cabinet was in very nice condition with all the knobs still present, so I agreed it was worth a look at least.

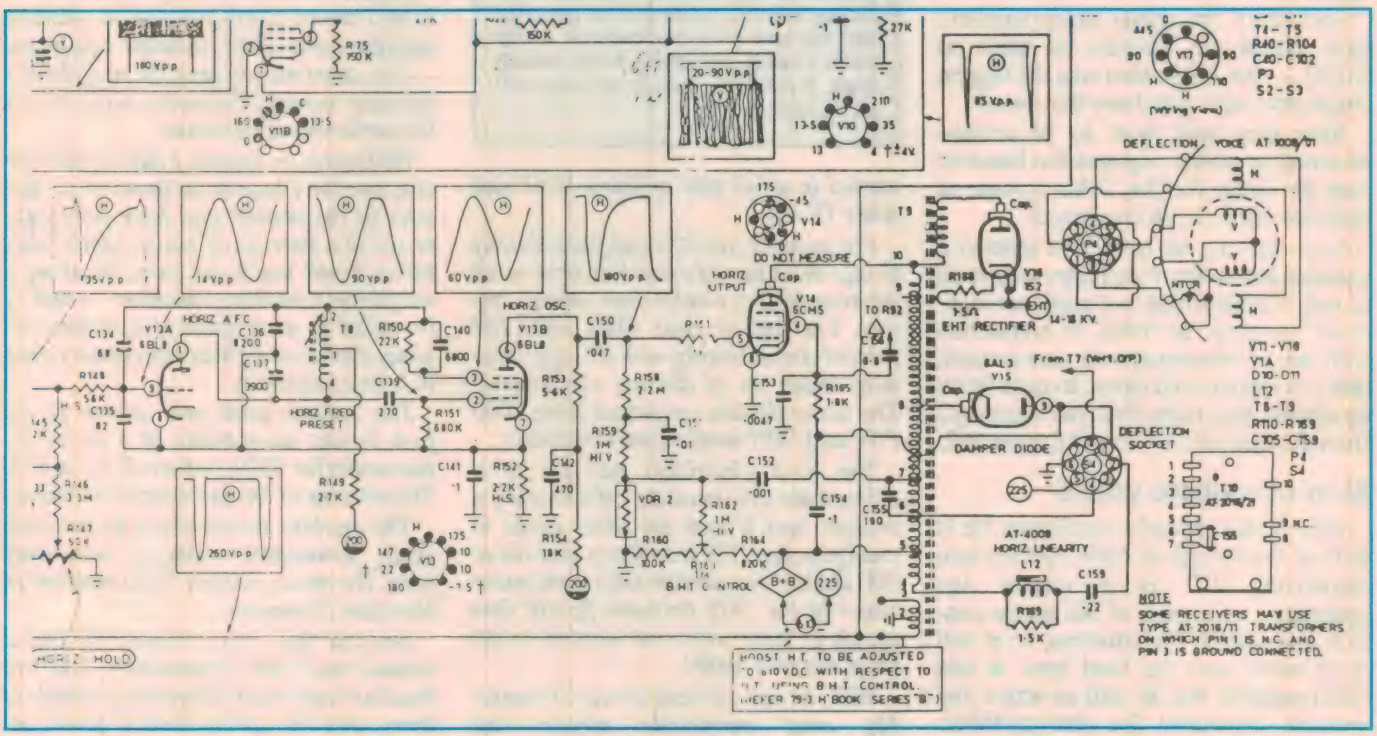
I removed the back and, seeing no overt signs of catastrophe, gingerly switched it on, to be greeted by a really impressive 'Jacob's ladder' type display from a hole in the tripler, accompanied by a frightful hissing and spitting. Small wonder the previous owner threw it out!

Rank triplers are notorious for doing this of course, but I was further irritated by the stupidity of the mounting arrangement. A sharp-edged metal bracket was sited right up close to the tripler case — just the thing to encourage a corona discharge and eventual breakdown of the plastic.

The usual approach to fixing such holes, (apart from replacing the tripler) is to plug them with Araldite or silicone rubber. However, I soon found something a lot quicker and far more convenient — a hot melt glue gun!

A liberal layer of the stuff stopped the arcing stone dead. It's a great insulator — an earthed jumper lead placed right on the glue layer failed to provoke any further pyrotechnics.

Alas, I was rewarded for all this effort by a yellow picture. Suspecting the worst, I shorted the blue cathode to chassis. Sure



Our contributor B.T. was called out on one occasion to repair a 23" Kriesler monochrome TV receiver, to be confronted with a central vertical line instead of a picture. Although at first he couldn't imagine how such a fault could be produced, he found in reality that the fault was quite simple. In fact, the same fault can occur with modern colour sets...

enough, the blue gun had virtually no emission. Instead of the expected bright blue screen with retrace lines, I got nothing at all. "#%&?!!", I said (or words to that effect).*

The red and green guns seemed to have plenty of emission though, so I decided to don the ceremonial striped apron that I keep cleaned and pressed for occasions such as this, and to see if I couldn't frighten some life back into the blue gun.

For this kind of job, professional servicemen often carry a special 'CRT rejuvenator'. Fitted with the appropriate tube socket, these devices work by forcing an unusually heavy current between the cathode and control grid for a brief period.

If you are lucky, this blasts away some of the contaminated cathode material, exposing fresh oxide and so restoring emission. Unfortunately, used carelessly, it can also blow off ALL the oxide, rendering the cathode useless.

Not being involved in domestic servicing anymore, I don't own one of these gadgets, but I have had some success in the past by grounding the offending cathode and briefly connecting the grid to the HT line (usually 120 to 150 volts), through a 1k 20 watt resistor. Hopefully, this will force enough current through to 'boost' the cathode.

But not this time. I couldn't get any significant current to flow at all. For this situation, most tube rejuvenators have provision for applying extra heater voltage, which will often help get things started.

I decided to improvise, by winding five turns of insulated wire around the line output transformer core and running the tube heaters off this. My true-RMS voltmeter indicated that this was producing the equivalent of a little over eight volts, which was about right for the application.

But I still couldn't get any emission. I decided that there'd be no more Mr Nice Guy — I touched the 1k resistor onto the collector of the horizontal output transistor. That did it! (Hardly surprising, with 1400V line pulses applied to the grid). With the cathode still grounded, the screen was now a vivid blue.

With everything returned to normal, and the greyscale pots all adjusted, the old banger was giving an absolutely first-class picture and I was feeling really pleased with myself.

My elation was short lived, however. The next day the picture had gone distinctly yellow again, although there was still SOME blue. I tried 're-zapping' the cathode, this time to no avail.

I was able to restore a passable picture by re-connecting the eight volt winding to the heater, but no way could I get the picture as good as it was before. Nevertheless, my colleague was happy enough with the set, and I suppose the picture wasn't all that bad.

But it's all a big mystery to me. There must be some ex-employee of the thermionic valve era out there who can explain what the precise mechanism of 'zapping' is, and how it is possible to have a cathode that works brilliantly one day, only to be almost dead the next morning.

On the subject of heater-cathode shorts covered in 'The Serviceman' for July 1992, I have used the same technique, but for intermittent shorts I have discovered an alternative 'therapy' which is somewhat more convenient to use.

You simply clip a 1uF polyester capacitor (electrolytics are no good) between the offending cathode and ground. (That is, right on the cathode pin, not the video output transistor's collector). You then gently tap the neck of the tube. With any luck, when the capacitor is removed, the fault will have vanished.

The heater-cathode shorts are said to be caused by tiny metal 'whiskers' that grow on the cathode. When the short is not present, the capacitor will charge up to the collector voltage of the relevant video output transistor, usually around 120V.

When you tap the tube neck, the 'whiskers' will try to short the capacitor to ground, and get their ends blown off for their trouble! (Although nothing obvious seems to happen).

I have resurrected many t ubes over the years in this fashion, and only one has 'bounced' — it developed a short in another cathode! (Which I was also able to fix...)

There is a slight risk that you may make an intermittent short permanent with this technique, (although it's never happened to me). But if so, you won't be any worse off. I have also tried blasting away permanent shorts with the same capacitor, but with no success. Perhaps a bigger capacitor might do the trick, but it might also open-circuit the heater, removing the isolated heater option!

Thanks, K.W. Those tips might inspire some of our readers to try to salvage otherwise useless sets. I have a professional tube tester/rejuvenator, made by RCA in the USA, and it works in much the same way as your experimental rig. I might have a few more precise adjustments perhaps, but that's about all. And my machine cost me many hundreds of dollars back in the mid-seventies!

As for what causes cathode polution, I've heard several stories but the one I give most credence to is this:

No matter how 'hard' the vacuum in a new picture tube, there will always be some out-gassing during use and these gas atoms will occasionally be bombarded by the electron beam. The beam will knock electrons off the atoms, turning them into positive ions.

These heavy ions are attracted by the negative cathode and drift back along the tube until they lodge on the cathode surface. It is said to be an accumulation of these gas atoms on the cathode that results in poisoning of the surface and the consequent lowered emission.

'Boosting' the tube consists mainly of stripping away this poisoned layer, to expose the fresh uncontaminated material below. Unfortunately, only the earlier delta gun tubes have cathodes large enough and heavy enough to withstand this treatment. More modern tubes have small, thin cathodes with insufficient coating to allow any of the stripping that is so effective in the older tubes.

Overheating the cathode by increasing the heater voltage is said to 'boil' the cathode coating, thus mixing the poisoned material into good stuff. This often improves the tube emission, without the violent stripping involved with the process mentioned earlier.

There may be other reasons for lowered emission, and other explanations of why tube boosting was but is no longer effective. If any reader has another story, I'd like to hear it. Anyway, thanks again, K.W. We'll watch out for your next story.

And that just about winds up this month's column. We have quite a number of contributors stories on hand, but never so many that we won't accept more.

And don't forget our 'Just for a Laugh' segment. A hundred or so amusing words can earn you $25! ❖

Fault of the Month

AWA video recorder AV47

SYMPTOM: Snowy picture, both off tape and off air. Any tape recorded on this machine also gives a snowy picture on any other machine.

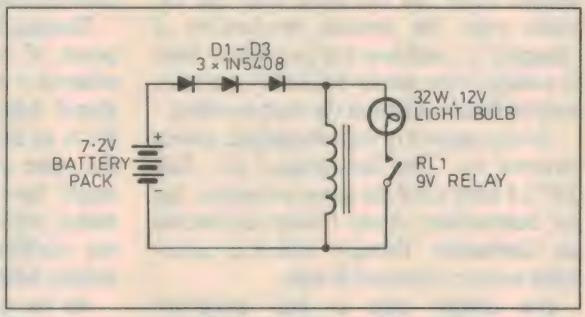
CURE: The RF modulator unit was defective. This unit includes the antenna booster amplifier, and in this case both sections became defective at the same time. The module is not meant to be repaired, so replacement is the only practical treatment.

This information is supplied by courtesy of the Tasmanian Branch of The Electronics Technicians' Institute of Australia (TETIA). Contributions should be sent to J. Lawler, 16 Adina Street, Geilston Bay, Tasmania 7015.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide further information.

NiCad discharger



Here is a simple (and cheap!) circuit for discharging NiCad battery packs. It was designed specifically for 7.2V packs, though it could be modified for other voltages. The idea, of course, is to improve the life of the packs by fully discharging them before recharging. However, if the packs are allowed to fully discharge rapidly, then individual cells within the packs may be damaged.

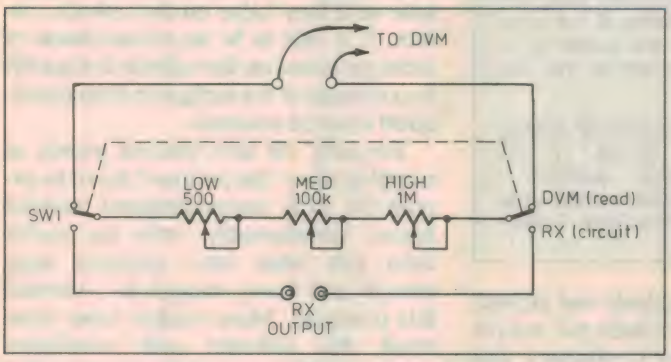
This could occur if one of the cells discharges more rapidly than the others and once 'flat', subsequently becomes 'reverse charged' by the other cells. The accompanying circuit overcomes this problem by quickly discharging the pack to about 3V, and then slowing the discharge rate considerably. The three 3A power diodes (1N5408) reduce the initial voltage across the 9V relay coil to about 5.2V, which is sufficient to turn the relay on. (My DSE mini relay comes on at 5V and turns off at 3V.) With the relay on, the pack rapidly discharges through the 32W, 12V light bulb (at about 1.2A) until the voltage falls to about 3V, when the relay will drop out.

The pack will further discharge through the relay coil (more slowly, though, at about 10mA) down to around 2V (the voltage drop of the diodes). After that, the pack discharges only very slowly, as though disconnected from the circuit (about 1% per day). If you wish to monitor the battery state, a voltmeter could be included, although this would increase the cost.

The credit for this circuit actually belongs to Chris Thomson of Fairlight, and it is published with his permission.

John Loadsman,
Stanmore, NSW **$40**

Circuit resistor substitute



Having built this simple device, and found it to be so effective and useful, I felt that I just had to share it! It provides a substitute resistor with a value from 100 ohms to 1M, and can easily be switched between being connected to the circuit under test, and reading the resistance value on your DVM (set to an appropriate resistance range).

Once connected, the value of the substitute resistor can be varied and the circuit performance checked. Throw the switch and get a readout of its precise value (limited only by the accuracy of your meter). Note that the RX output is open circuit when the switch is in the DVM position. As the three potentiometers are in series, a fine adjustment can be made for any reading by using the 500 ohm pot. I used log type potentiometers, fitted with large size knobs to give good control. All three pots can be calibrated to give standard resistance values.

By using short leads (about 100mm long) fitted with banana plugs for the meter connection, and banana sockets for the RX output, the device is quickly set up and is easy to use. The switch can be either a rotary or slide type.

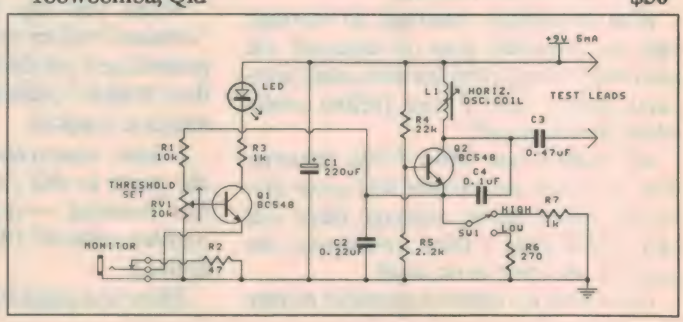
Colin Bowring,
Massey, NZ **$40**

Shorted turns tester

This circuit tests for shorted turns in many inductors from HOTs (horizontal output transformers) to motor windings. Originally derived from an early *EA* circuit, which used the then many-purpose OC71 and a meter, its use has proved valuable — especially testing transductors, transformers, etc. on colour TVs.

Transistor Q2 forms a self oscillating circuit with a normal run-of-the-mill horizontal oscillator coil salvaged from a TV. Transistor Q1 forms the detection circuit for monitoring the frequency change of Q2, via a LED which is set to just light by variable resistor RV1. Audio/meter monitoring is also possible by plugging into the 'monitor' jack a high impedance speaker/phones or a suitable milliamp meter. As the frequency is fairly high, some may find the audio part fruitless. Adjust RV1 until the LED just lights, then with the test leads across a good winding of a HOT and with switch SW1 set to 'high', adjust the horizontal oscillator coil slug to give maximum brightness. From now on the oscillator is set. To test low impedance windings such as motors, iron-cored inductors, set SW1 to 'low'. Switch SW1 to 'high' for HOTs and other high impedance inductors. Shorted turns on an inductor result in a lowering of the frequency or no oscillation at all, causing the LED to become dull or go out. 'Good turns' will increase the frequency, with a corresponding increase in LED brightness.

Warwick Talbot
Toowoomba, Qld **$50**



Seven day indicator

Digital alarm clocks based on the MM5387 and similar chips have no output to allow you to make whole week alarm settings. By adding this circuit you can set your alarm for any particular day, as you can with most VCRs.

To do this, four outputs are taken from the clock chip: AM, PM, Colon and Alarm output. The AM and PM outputs are used to make a clock pulse for the decade counter IC1 as the clock reaches midnight. Note that the current limiting resistors R12 and R13 are not needed if similar resistors exist in the clock display circuit, before the AM and PM outputs.

The clock pulse is produced when the time changes from 11.59pm to 12.00am. At this point, the AM output goes high and the PM goes low. However, because the PM output connects to the base of transistor Q1 (C1383) via an RC network (R10/C1), it remains high for about 0.1s after the changeover.

So the AND gate IC4a produces a 0.1s pulse, incrementing the counter. The status of the counter is indicated by one of the seven 'day' LEDS.

The same seven 'day' outputs are also ANDed with seven day selector switches, SW1-SW7, in IC2 and IC3. The outputs of the AND gates are isolated via diodes D1-D7, allowing more than one day to be selected.

So IC4b has a positive voltage applied to its pin 12 whenever a selected switch matches IC1's 'day' output. The output of IC4b will now go high when pin 13 also goes high — which occurs when the alarm output of the clock chip (pin 25) is activiated the output from pin 11 can be amplified and used to drive a relay or buzzer.

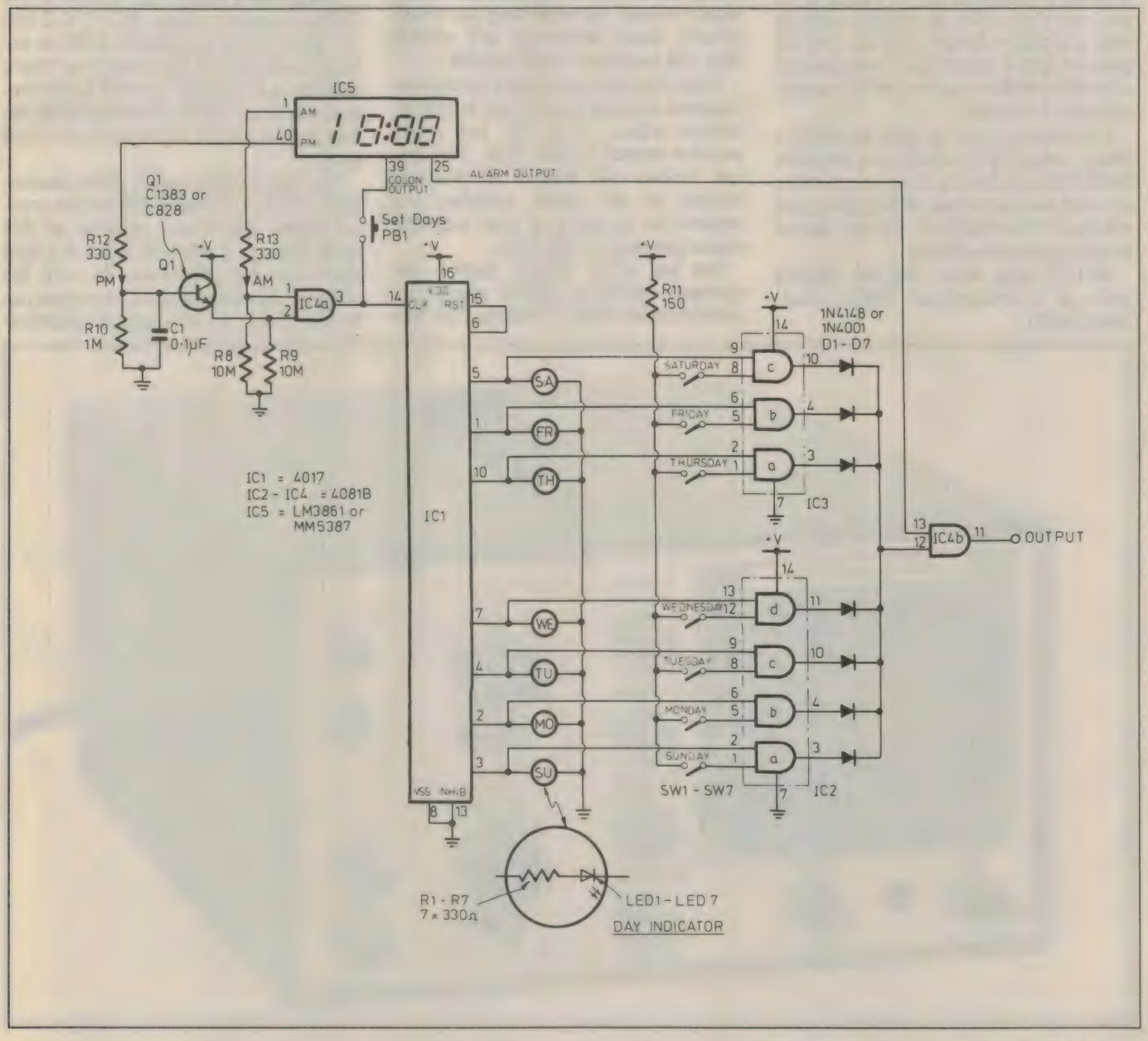
It will remain high for the usual 59 minutes, or until turned off. This time is controlled by the alarm clock itself.

To set the 'day' on IC1, press PB1 to advance the counter with 1Hz pulses from the colon output (pin 39) of IC5.

As well as being used for authomatic recording of radio or TV programmes, the one pulse/24 hours can also be used to drive a calendar clock, by using additional counter chips and seven segment displays.

The circuit will work with any type of digital clock, except those in which multiplexing is used. It is possible that this circuit could interfere with some clock modules.

Fawad Hafeez,
Karachi, Pakistan **$40**



Compact, low cost CRO:

6.4MHz TI-3051 Circuitmate

Another new measuring instrument for 1993 from Jaycar is a compact, low cost oscilloscope, which features a 75mm cathode ray tube. You can now view electrical waveforms under various conditions for a relatively modest outlay.

by PETER MURTAGH

A cathode ray oscilloscope (CRO) is an extremely useful measuring instrument when working with electronics, as it lets you actually view the waveforms of the signals you are investigating. A lot of relevant information can be hidden if all you can do is take an average reading with a digital voltmeter (DVM). But the price of such a higher level instrument is often beyond the resources of the average electronics hobbyist.

Fortunately, there is now available a basic, budget CRO, which costs less than $400. While it doesn't allow you to make accurate measurements of frequency and voltage, it does fulfill the primary aim of displaying the waveforms.

And it costs about half the starting price of a conventional 20MHz dual-trace model.

The front panel

The viewing screen is ruled up with eight vertical and ten horizontal divisions, both using a 6mm grid. Surrounding the screen are the usual CRO control knobs: beam intensity (incorporating the on-off switch), focus, horizontal and vertical shift, and 'sweep var' and 'variable'.

These last two knobs give continuous variation between the top and bottom of various scales, set by the two rotary switches located to their right. This system reduces the number of positions needed on the rotary switches, but reduces the accuracy of your measurements (see more on this later).

The top rotary switch controls the timebase circuit, to provide sweep frequencies from 10Hz - 200kHz. The first five positions define the 10:1 internal sweep ranges (10Hz - 100Hz, 100Hz - 1kHz, etc.), though the top scale only goes from 100kHz - 200kHz. The sixth position is used for external sweep.

Immediately below this control is the SYNC selector switch: INT, TV, LINE and EXT. When you use the CRO in external sweep mode, the 'sweep var' knob doubles as a 'set gain' control for the external X-input, which is connected to the two sockets on the top right of the front panel.

The lower rotary switch gives attenuations of 1:1, 1:10 and 1:100 for the vertical signal. The fourth position on this knob displays a nominal 50Hz, 0.2Vp-p sine wave for calibration. As with the timebase frequency control, the signal can be varied over a 10:1 range of amplifica-

tion (using the 'variable' knob). The coupling signal switch is located below the rotary switch, giving the usual AC, GND and DC choices.

You can also use the CRO to align TVs and radios. To do this, you need a sweep/marker signal generator to produce a sawtooth waveform to be fed into the external inputs on the front of the CRO, and a series of marker pulses to be fed into the marker sockets on the back.

Controls on the back panel allow you to switch between negative and positive polarity pulses, and to alter their magnitude (input pulses can be between 1.5V and 50Vp- p).

Specifications

The Circuitmate (designated by the manufacturers as the TI-3051) claims a vertical sensitivity of 10mV per division, with a frequency bandwidth of DC - 5MHz, or DC - 6.4MHz (-3dB). The horizontal amplifier has a sensitivity of 300mV/div for a bandwidth from DC to 250kHz.

The input impedance of both amplifiers is a nominal 1M, in parallel with 35pF, while the maximum input voltage, for less than one minute, is 600Vp-p for the vertical and 100Vp-p for the horizontal amplifiers, respectively. The vertical attenuator accuracy is quoted at within 3%.

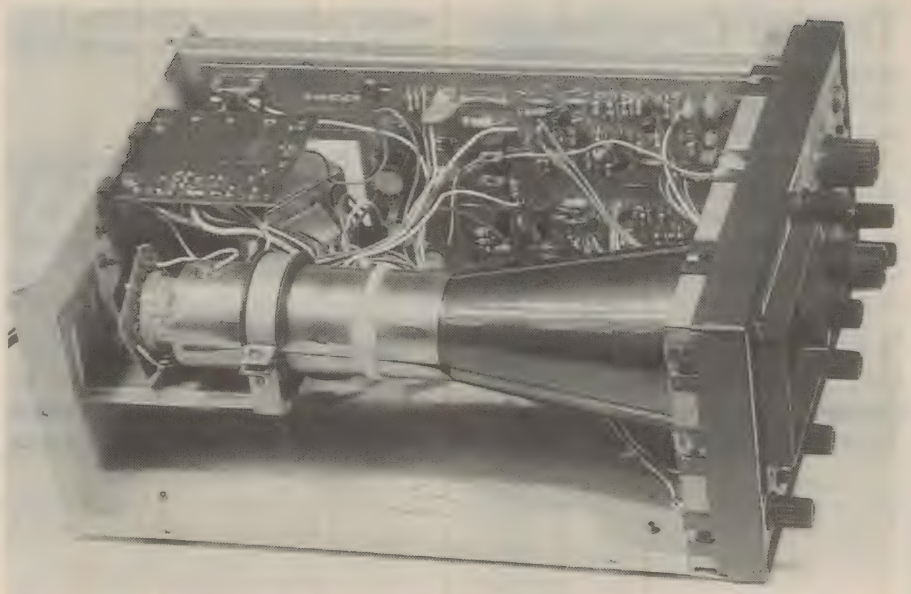
Inside the case

By removing four screws on each side of the metal case, and two more on the top, we were able to lift off the lid and view inside. Interestingly, nowhere on the case or any of the printed circuit boards, was there any indication of the country of origin of the instrument! (We presume it was Taiwan or Korea.) There were three PCBs inside, the mains transformer and the cathode ray tube.

The CRT takes up most of the space inside, running the full depth and almost half the width of the case. The first PCB is fastened along the other side, with an area almost the same as the side panel.

This contains most of the circuitry, as the other two boards are quite small. Both of the smaller boards are fastened at right angles to the main board — the first behind the front panel, and the second just under, and parallel to, the lid. The power transformer is tucked in under the large PCB.

With the lid removed, the third PCB sits high and exposed. Since high voltage connections are made to this board (including the 1200V accelerating voltage for the electron beam), this could easily be a safety hazard. We believe that there should be some layer of insulating material covering this board, to prevent accidental contact when the lid is removed for servicing.

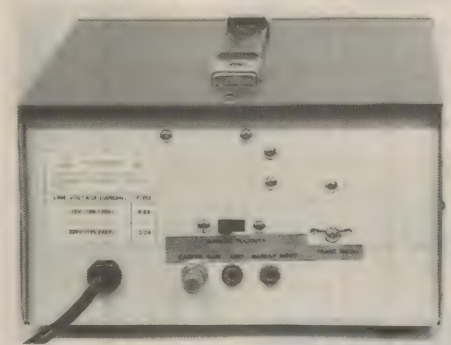


The cathode ray tube takes up almost half the inside of the case. The bracket attached to the left end of the tube allows the trace to be rotated. Note the exposed PCB (above the bracket) which has high voltage connections.

The large PCB also accommodates the four trimpots for making calibration adjustments (detailed in the manual). Unfortunately, it is very difficult to see their labelling, and there is no PCB layout diagram given.

On the set sent for review, the vertical DC balance needed adjustment, because changing the vertical gain caused the horizontal trace to move also. We would have appreciated a diagram which showed where the relevant trimpot VR1 was located.

We also found it necessary to adjust the horizontal trace, since it sloped up considerably on the screen. This adjustment is supposed to be possible by loosening two screws on the back of the case, and rotating a plate fixed to the back of the CRT. The top screw acts as a pivot, while the lower one slides along a slot. But we found that this system couldn't give us sufficient movement to correct the trace.



The marker sockets and controls on the back of the case are used when aligning TVs and radios. The 'markers' are added to the display of the output signals from the receiver being tested.

So, while the case was open, we decided that this was the time to fix it. We loosened two more screws which held a saddle around the cylindrical section of the tube, grasped it firmly, and attempted to rotate it. Because the front end of the tube was held very tightly with a clamping strap, it took quite an effort before it moved.

However, it did move when sufficient force was applied, very carefully, at the screen end (and keeping a watchful eye on the high voltage connections on the exposed PCB, already mentioned). So, we were finally able to achieve a horizontal trace, but certainly not by using the method outlined in the manual.

Trying it out

The Circuitmate produces a reasonably sharp trace, though there is a small amount of AC power interference visible. The presence of banana sockets for signal input, rather than the more usual shielded BNC type, shows that the model does not pretend to be a highly sensitive instrument.

We made several measurement on the CRO, to check it out. All of them were within the quoted specifications. The sine wave frequency response remained flat right up to 5MHz, dropping off to 71% of the signal (-3dB) at around 6.5MHz. When we used a square wave input, the wave retained its shape almost up to 1MHz, after which the loss of the higher order harmonics meant the square

shape became more and more like a sine wave. Of course, these quoted figures are only approximate, as it is difficult to claim that any measurements made on the small 60 x 48mm screen are really exact.

The X and Y sensitivity readings were both better than quoted. In EXT mode, with the horizontal gain turned to maximum, a 1.513V DC voltage was needed to produce a full 10-division movement of the dot; while the voltage needed for full vertical movement (with 1:1 attenuation and maximum gain) was 64mV. These values equate to horizontal and vertical sensitivities of 150mV/div (compared to the quoted 300mV) and 8mV/div (10mV), respectively.

Calibration

The manual quotes the calibration waveform as being 0.2Vp-p, 50Hz. We adjusted the X and Y gain controls to make both the wavelength and peak-to-peak amplitude of this wave four divisions on each grid. We then fed in a 4Vp-p, 1kHz wave to test its accuracy.

With the controls set to the 100Hz - 1kHz frequency scale, and the 1/1 attenuation, we found that the Circuitmate gave a reasonably accurate frequency measurement, but that the amplitude was out by a factor of '2'! The calibration wave really was 0.4Vp-p, not 0.2V as stated. (Perhaps what was meant was 0.2V 'peak', not 'peak-to-peak'?)

If the vertical gain is not altered after calibration, then voltage measurements can be made which will be reasonably accurate.

However, the same method can't be used for frequency, because the horizontal gain has to be adjusted to give a stable waveform (there is no separate 'trigger' control). And once the X-gain knob is changed, the frequency calibration has gone.

Improvements

Our main concern has already been mentioned — the lack of an insulation layer over the PCB which carries exposed high voltage connections.

Other minor defects on the model sent for review include the need for us to adjust both the trace alignment and DC balance. Also, the plugs on the test lead supplied were held so closely together by a protective sleeve over the wires, that we couldn't plug them into their sockets without tearing the sleeve.

And then there's the manual: it has many spelling mistakes, wrongly numbered parts, and incorrect instructions like 'remove screw 22' (when making the trace alignment) which should have read 'move screw 21', etc. The manual does convey the necessary information, but with a degree of annoyance. Maybe this is the price we have to pay for budget equipment?

Summarising

For those without a big budget, but who want to view actual waveforms, the Circuitmate fits the bill. It allows voltages to be measured with reasonable accuracy, though frequency measurements will usually only be approximate. With the exception of a few areas mentioned above where improvements could be made, we believe that this unit gives good value for money.

The Circuitmate measures 210 x 118 x 300mm, and weighs 3.8kg. It comes supplied with a shielded lead terminated in banana plugs and alligator clips, and is available from all Jaycar stores (Cat. No. QC-1908) for $379. ❖

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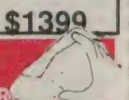

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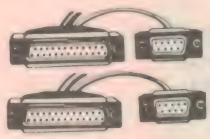

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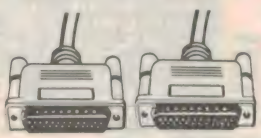

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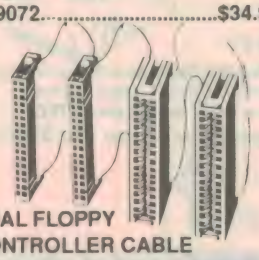

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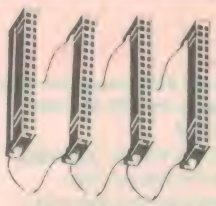

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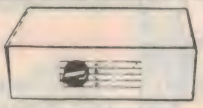

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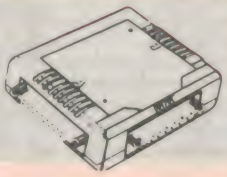

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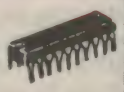
74HCs



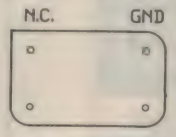
CAT. No.	Description		price
Z77000	74HC00	Quad 2-input NAND	$1.20
Z77002	74HC02	HS CMOS 2 INPUT NOR	$0.75
Z77004	74HC04	Hex Inverter	$0.75
Z77008	74HC08	Quad 2-input AND	$0.75
Z77010	74HC10	Triple 3-input NAND	$0.75
Z77011	74HC11	Trpile 3-input AND	$0.75
Z77014	74HC14	Hex Schmitt Trigger	$0.80
Z77020	74HC20		$0.80
Z77027	74HC27	Tripple 3-input NOR	$0.60
Z77030	74HC30	8-input NAND	$0.80
Z77032	74HC32	QUAD 2 INPUT OR GATE	$0.80
Z77042	74HC42		$0.90
Z77051	74HC51		$0.90
Z77074	74HC74	Dual D Flip Flop, +ve Edge Triggered	$1.10
Z77075	74HC75		$0.80
Z77076	74HC76	Dual J/K Flip Flop, -ve Edge Triggered	$0.80
Z77085	74HC85	4-bit Magitude Comparator	$1.40
Z77086	74HC86	Quad 2-input Exclusive OR Gates	$0.90
Z77123	74HC123	Dual Retriggerable Monostable	$0.90
Z77132	74HC132	Quad 2 input NAND	$1.25
Z77138	74HC138	3 to 8 Decoder	$1.40
Z77151	74HC151		$1.00
Z77157	74HC157	Quad 2 to1 Multiplexer	$1.00
Z77161	74HC161	HCMOS COUNTER	$1.25
Z77163	74HC163		$1.00
Z77164	74HC164		$2.25
Z77174	74HC174	Hex D Flip Flop with Clear	$1.00
Z77175	74HC175		$1.00
Z77180	74HC193	4-bit U/D Binary Counter, 2-clocks	$1.95
Z77240	74HC240	Octal 3-stateInverting Buffer	$1.50
Z77244	74HC244	Octal 3-stateBuffer / Line Driver	$1.20
Z77245	74HC245	Octal 3-state 2 way Buffer	$2.50
Z77273	74HC273		$2.75
Z77367	74HC367	Hex 3-state Buffer	$1.95
Z77373	74HC373	Octal 3-state D-type latch	$1.80
Z77374	74HC374		$1.25
Z77393	74HC393	Dual 4-Bit Binary Counter	$1.20
Z78402	74HC4020		$1.20
Z78404	74HC4040		$1.65
Z78406	74HC4060		$1.50
Z78407	74HC4066	Quad Analog Switch	$1.50

74HCT

Z78500	74HCT00	QUAD 2-INPUT NAND	$1.20
Z78510	74HCT02	QUAD 3 INPUT NOR	$1.20
Z78530	74HCT08	QUAD 2 INPUT AND	$1.20
Z78540	74HCT10	TRIPLE 3 IN NAND	$1.20
Z78544	74HCT21	DUAL 4-INP AND	$1.50
Z78550	74HCT123	DUAL RETRIG MONO	$1.20
Z78560	74HCT139	DUAL 2-4 LINE DEC	$2.50
Z78570	74HCT240	OCTAL BUF LINE DRIVE	$2.50
Z78580	74HCT241	OCT BUF LINE DR	$2.50
Z78590	74HCT244	OCT BUF LINE DR	$2.95
Z78600	74HCT245	OCT BUS TRANS	$2.95
Z78610	74HCT253	DUAL 4CHAN MULTIPLEX	$2.95
Z78620	74HCT273	OCTAL D TYPE F/F	$2.95
Z78640	74HCT373	OCTAL D LATCH	$2.95
Z78650	74HCT374	OCT D FLIP FLOP	$2.95

DIL Crystal Oscillator Modules

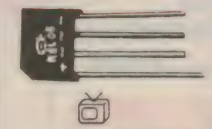
Y11128	25MHz	$9.95
Y11130	33MHz	$6.95
Y11135	40MHz	$9.95
Y11140	50MHz	$9.95
Y11142	66MHz	$11.95
Y11145	80MHz	$18.95



Rod Irving stocks a range of TTL quartz crystal oscillators housed in hermetically sealed all metal packaging. The Outputs are TTL compatible and sink up to ten 1.6mA TTL loads. CMOS loads can also be driven by connecting a 2K2 Ohm resistor between the output and positive supply pins.

Technical Specifications
- Frequency Tolerance: +100PPM overall 0° to 70° C
- Supply Voltage: 5VC +10%
- Supply Current: 35mA max.
- O/P symmetry 55/45% @ 1.4VDC level
- Rise and fall times 10nS Average (0.4 to 2.4V Max.

DIL INLINE BRIDGE

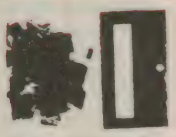


KBV06 6 AMP 600V
Service Persons!
You need to keeep a few of these in our parts box

	1-9	10+.
Z10460	$5.95	$4.50

5 AMP TWIN DIODES
C4123 Twin Diode 600V
Z10480.....$9.95

ELECTRONICS VALUE PACKS



- .25W 1% Metal Film Pack.
- Contains: Approx: 250

R19001.....$5.95

.25W Carbon Film Pack
- Contains: Approx. 250

R19010.....$4.75

- 50V Ceramic Pack
- Contains: Approx 100

R19020.....$5.95

- Polyester Cap Pack
- Contains: Approx 50

R19030.....$5.25

PCB Electro Pack
- Contains: Approx. 50

R19040.....$6.30

FUSE PACKS
3AG pack of 40 ($10 value)
Contains: 4 x 500mA,
8 x 1A, 6 x 1.5A, 2 x 2A,
6 x 3A, 4 x 5A, 2 x 7.5A,
4 x 10A.
Cat:S15992..... **$9.95**

M205 Pack of 40
($10 value)
Contains : 5 x 500mA,
10 x 1A, 10 x 2A, 5 x 3A, 5 x 5A,
5 x 10A,
S15994..... **$9.95**

MIXED IC SOCKETS
100 Units ($37.00 Value)
Contains: 15 x 8 pin,
20 x 14 pin, 10 x 16 pin, 10 x 18 pin ,
5 x 20 pin, 10 x 22 pin, 5 x 24 pin,
5 x 28 pin, 10 x 40 pin,
P10546.....$24.95

DIODE PACKS
100 per pack
1N4002 (1A 200V Rectifier)
Z10103.....$4.95
1N4004 (1A 400V Rectifier)
Z10106.....$5.95
1N4007 (1A 1000V Rectifier)
Z10112.....$6.95
1N914 / 1N4148
Z10135.....$3.95
1N5404 (3Amp 400V)
Z10114.....$12.95

LED MIXED PACK
(Red only 5mm)
Approx. 100 pieces
Z10138.....$11.95

LED MIXED PACK (MIXED COLOURS)
Approx. 100 pieces, 5mm
Contains 50 red, 25 yellow,
25 green.
Z10136.....$14.95

MIXED SCREW PACK
Approx. 100 pieces. This pack is a must for elecronic handymen and computer servicemen. Contains screws for computer cases, disk drives etc.
H10960.....$7.95

MIXED POLYESTERPACK
(In IEC package)
Approx. 50 pieces
R15120.....$9.95

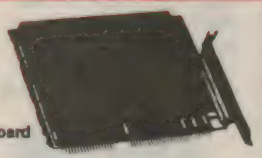
DECODED PROTOTYPING BOARDS

The Prototyping cards are for those people whom want to configure their own bus interface.
+5V and GND surround the edge of all cards. A space exists for a 25 way or 37 way D female ribbon connector at the rear of the cards .
The decoded prototyping cards are designed for PC add-on card designers. They area superior alternative to the pure prototyping card as they offer extra features not provided on similar cards. The built-in basic circuits include address decoding and data bus buffering. This card can eliminate the time required to design and implement I/O and control projects. The features offered by the cards are those of space to put a power supply connector so that you can power your prototype circuit independently from the main system. A space for keyboard and D connectors are also included. The bus signals are labelled to save you time, and the decoding circuitry gives 512 switch selectable I/O address locations for the card.

EXTENSION BOARD
H19120.....IBM PC/AT Extension board P01.
155mm (L) x 104mm (W).....**$90.00**

DECODED PROTOTYPING BOARDS
H19125.....IBM PC/AT Decoded prototyping board P02 334mm (L) x 104mm (W) 2890 plated through holes...**$94.00**

H19127 IMB PC/XT Decoded prototyping board P03. 334mm (L) x 104mm (W). 2890 platted through holes... **$89.00**



Extension Board H19120

Decoded Prototyping Board H19125

H19127

COMPLETE IDIOT'S GUIDE

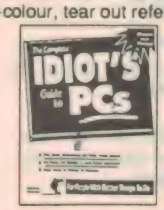
For people with better things to do

The complete idiot's guide series delivers information that evryday users need and want to know, not everything there is to know. The authors personal writing style and *"we're all in this together"* attitude take the edge off a new technology.

Information is presented in short, magazine-like sections, which make it easy to skim and find information. Humorous asides, an open design, and cartoon illustrations provide a friendly learning atmosphere. Real-life examples and ideas for practicle applications show readers what they can do with a computer, not just how to make the parts work.

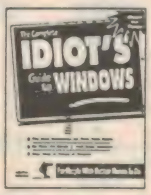
SPECIAL FEATURES:

- *"What's wrong with this Picture"* illustrations that show PC pitfalls.
- *"Opps"* tips that tell readers how to avoid and get out of trouble spots, interesting side notes that satisfy the readers curiosity.
- *"Speak like a geek"* glossary, cross-referenced index, and a convienient four-colour, tear out reference card.



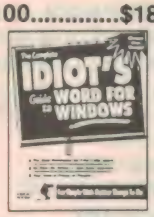
Complete Idiot's Guide to PC's Beginning/intermediate

B24100.....$18.95



Complete Idiot's Guide to Widows Beginning/Intermediate

B24102.....$18.95



Complete Idiot's Guide to Word for Windows Beginning/Intermediate

B24104.....$18.95

Complete Idiot's Guide to DOS Beginning/Intermediate

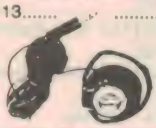
B24106.....$18.95

EARPHONES

MAGNETIC EARPHONE

90 cm cord with 3.5mm plug.

A12113.....$4.95



DYNANIC EARPHONE

High Quality earphone with hook for hanging onto ear.

SPECS:

Freq. response: 20Hz-18kHz

Impedance: 8-50 ohms

Sensitivity: 98dB/mW

Cord/Plug: 4.5/3.5mm

A12115.....$13.95

MAGNETIC EARPHONE

6 metre twisted cord with 3.5mm plug. With hook for hanging onto ear. Pink i colour.

A12114.....$5.95

EARPADS

Earpads to suit lightweight phones.

Foam earpads packed four to a card.

- 27mm earphone size

A12120.....$3.95

Earpads to suit inner ear phones

- Foam earpads packed four to a card
- 13mm earphone size.

A12121.....$2.50

RIE also has a large range of headphones for every budget. Plus a large range of audio plugs and leads!

WE HAVE JUST INCREASED OUR ALREADY LARGE RANGE OF SPECIAL FUNCTION SEMICONDUCTORS

Cat. No.	Description	Price 1-9	10+
T90018	BA159 FAST RECOVERY DIODE	$1.50	$1.35
T90020	BB212 SILICON VARICAD	$5.95	$5.35
T90275	BD 679 DARLINGTON TRANSISTOR	$2.40	$2.20
T90298	BFR84 N CHAN MOSFET	$4.95	$4.40
T90299	BFR91 RF NPN TRANSISTOR	$4.95	$4.45
T90306	BR100 DIAC	$0.95	$0.85
T90310	BUZ11	$5.95	$5.35
T90312	BUZ71	$1.95	$1.75
T90314	BY229-400	$4.95	$4.45
T90316	BUK455-60A POWER FET	$6.95	$6.45
T90320	BYX98/300 REC. DIODE 10AMP	$16.95	$15.10
U10160	TL496 VOLT CONVERTER	$5.95	$5.35
U10166	TCM5087 DTMF DECODER	$3.75	$3.35
U10168	TMS3477NL VOICE RECORDER	$9.95	$8.95
U10188	TLC251 LOW VOLT POWER/CARD	$6.95	$6.25
U10189	TLE3101 VERSITILE TRIAL CONT.	$12.95	$11.75
U10420	MC145436 DTMF DECODER	$7.95	$7.15
U10478	10116 ECL TRIPLE LINE RECEIVER	$3.50	$3.15
U10850	CA30465 NPN TRANSISTOR	$2.95	$2.65
U11756	LM614 ADS FLOPTICAL VOLT REF.	$6.95	$6.25
U11988	SLB586 LIGHT DIMMER IC	$12.95	$11.65
U21580	ISD1016AP16 SEC VOICE/STORAGE/RECORDER IC	$39.95	$35.95
U22938	UL3906 SLA BATTERY CHARGER	$14.95	$13.45
U22940	UCN4202 4 PHASE MOTOR DRIVE	$4.95	$4.45
U22972	UPC1373H RECEIVER-PREAMP	$3.95	$3.55
U22990	VN10KM N CHAN MOSFET	$3.95	$3.55
Z10377	1N4936 1A 400V FAST RECOVERY	$0.90	$0.80
Z10466	SF52 SUPER FAST RECOVERY DIODE	$5.95	$5.35

ETHERNET CABLES

Made up and ready to use with Male to Male BNC connectors fitted.

2M 50 ohm cable.....$9.95

3M 50 ohm cable.....$11.95

5M 50 ohm cable.....$17.95

10M 50 ohm cable.....$27.95

20M 50 ohm cable.....$39.95

TERMINATION PLUGS

BNC plug terminations suitable for completing a network section, absorbing impluses and preventing termination.

50 ohm impedance

BNC TERMINATOR

93 ohm Arcnet 1-9 10+

P10528.....$4.95 $3.95

BNC TERMINNATOR

50 ohm Ethernet 1-9 10+

P10527.....$4.95 $3.95

THERMAL FUSES

These devises go permanently open circuit when they reach their rated temperature. Electrical rating is 15AMPs resistive at 250 VAC. These fuses are extensivly used in many electrical appliances such as electrical irons, jaffel makers,fan heaters, toasters hair dryers etc. We stock 7 types in two different sizes.

64mm

Opening temperature	Cat. No.
72ºC	S16200
128ºC	S16210
141ºC	S16220
167ºC	S16230
228ºC	S16240
240ºC	S16250

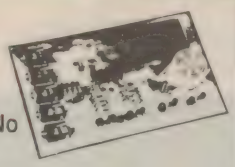
83mm

152ºC S16260

1-9 10+

$2.65 $2.50

LOW COST QUIZ GAME ADJUDICATOR



Host your own game show in your lounge room with this great little kit. No more arguing about who was first to answer the question. The "Quizmaster" lights a LED and briefly sounds a buzzer to indicate which four players pressed the button first. If your looking for a judge who's not bias, prejudice or favorable to family members or friends this is the kit for you.

K10390.....$29.95

MESSAGE RECORDER

The days of fiddling around with bits of paper stuck to the fridge to leave a message for someone have finally gone. The message recorder allows you to record up to 16 seconds of audio using a sound chip that retains the recording even when the power is turned off. It has many applications such as use as a doorbell, it could be built into an answering machine, or used to deliver instructions.

K10395.....$65.95

ISD10186AP 16 BIT VOICE CHIP AS USED IN THIS KIT.

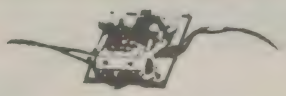
U21870.....$39.95

BEST SELLING KITS FROM OUR EVER INCREASING RANGE

GENERAL PURPOSE PREAMPLIFIER

A general purpose stereo preamplifier using a single LM382 IC which can be tailored for use with magnetic pickups, tape recorders, and microphones by changing a few components
(ETI445) (ETI July '76)

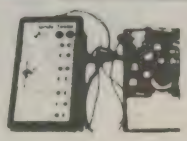
K10055.....$14.95



SOLAR GENERATOR

The ETI-569 Solar charger is designed to charge any standard 12 V lead acid car battery in any area where mains power is unavailable. It is ideal for remote data acquisition stations, caravans and boats.
Of course there are other solar chargers around, but these are extremely expensive. With the ETI-569 the emphasis is on simplicity and cheapness.

K10005.....$13.95



TRANSISTOR TESTER

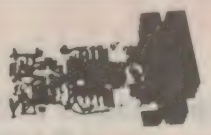
Have you ever desoldered a suspect transistor only to find that it checks OK? trouble shooting exercises are often hindered by this type of false alarm, but many of them could beavoided with an "in-circuit" component tester, such as the EA Handy Tester. (EA Sept. '83) 83TT8

K10080.....$22.95

ELECTRIC FENCE KIT

Main to battery powered, this electric fence controller is both inexpensive and versitile. Based on an automotive ignition coil, it sould prove an adequate deterrent to all manner of livestock. Additionally it's operation conforms to the relevant clauses of Australian Standard 3129. (EA Sept. '82) 82ef9

K10110.....$23.95

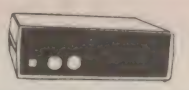


100 W AMPLIFER MODULE (ETI 480)

Similar to the above module but this one is 100 watts of power.

Heatsink optional extra

K10045.....$32.95



DISCOLITE

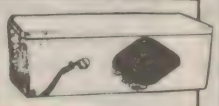
This kit makes your lights do amazing things. With 4 light channels controlled by 4 separate audio channels. Eg. Forward, reverse, auto reversing chaser patterns, alternating light patterns, adjustable rate for light patterns, simultaneous strobe on all four channels. Plus many more features! (Sil Chip July 1988)

K10130.....$155.00

ELECTRIC FENCE CONTROLLER

Restore the discipline to the farm or allotment with this new electric fence controller. It features higher output power and lower current drain than the previous design. (EA Dec. '85, 85ef11)

K10115.....$61.95



HIGH ENERGY IGNITION SYSTEM

Is your car still limping along with outdated Kettering ignition? What? You're still cleaning points, adjusting dwell, checking timer and all that automotive drudgery? Now you can fit this High Energy Ignition System and forget those tune-up hassles.
S.C. May '88.

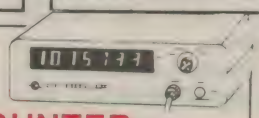
K10355.....$55.00

RGBI to PAL ENCODER/ MODULATOR

Here's the design for a low cost RGBI to PAL video encoder and RF modulator, suitable for use with an IBM or compatible computer fitted with a colour graphics adaptor (CGA). By providing a modulated RF signal on a suitable television channel, it allows a standard colour T.V receiver to be used as a colour monitor for games etc. E.A August '89.

K10335.....$49.95

NEW CHEAPER PRICE!!



1GHz FREQUENCY COUNTER.

Did you look at our latest 50MHz counter design longingly (because of its low cost), but finally decide against it - because you either need more resolution and/or opperation at higher frequencies ? Well, here is the 'big brother' of that design, offering seven digits of resolution and operation up to 1GHz. Despite the higher performance, the emphasis is still on the value for money - infact there probably isn't a cheaper way to get yourself a 1GHz frequency counter. (E.A. APRIL 93)

K10380.....$147.50

ROD IRVING ELECTRONICS. Est. 1977.

- **HEAD OFFICE**: 56 RENVER RD CLAYTON. PH: (03) 543 7877. FAX: (03) 543 2648
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- **NORTHCOTE**: 425 HIGH ST, NORTHCOTE PH: (03) 489 8866. FAX: (03) 489 8131
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- **ADELAIDE**: 241-143 WRIGHT ST, ADELAIDE PH: (08) 211 7200 FAX: (08) 211 7273.
- **RIE BULLETIN BOARD** (03) 562 7903 For Specials, Info & more. All Sales Tax exempt orders to.

RITRONICS WHOLESALE : 56 Renver Rd, Clayton, Victoria Ph: (03) 543 2166 Fax: (03) 543 2648.

Mail order & Correspondence: P.O Box 620, Clayton, Victoria, 3168

MAIL ORDER HOTLINE: 008 33 5757
STRICTLY ORDERS ONLY

Construction Project:

TEMPERATURE CONTROLLED MAINS POWER SWITCH

Here's the design for a simple unit which adapts a low cost digital electronic thermometer into a temperature-sensing mains switch. It can control the power to 240V loads of up to 1800VA, and can also be wired for either normally-on or normally-off operation.

This project was designed by the R&D people at Dick Smith Electronics, in response to a suggestion from Harold Siepmann of Grose Vale in NSW. Mr Siepmann saw some potential in adapting the Dick Smith Electronics 'Temp Alert' dual digital thermometer (Cat. No. Y-5011) to monitor and automatically control the heating of animal enclosures, particularly for volunteer animal welfare work.

The resulting unit has a maximum allowable mains load of 1800VA, which gives it quite a number of useful applications. Apart from things like animal enclosure heaters, fish tank heaters, ovens, room temperature control, etc., where the power is switched on when the temperature goes *below* a set threshold, it can also be programmed to switch on when the temperature goes *above* a set threshold — to control cooling devices like fans, refrigerators, water pumps and so on. To make it even more versatile, if desired the unit can be wired so that the switch contacts are normally *closed* with the switch not operated — for applications where the contacts will be closed most of the time (so that power is not wasted in keeping the relay operated), or where closed contacts would be considered fail-safe in the event of a power failure.

Applications for a normally-on switch include an automatic thermal cut-out, on any equipment where overheating is a possibility. One example of this use is to protect batteries that are being fast charged, where battery temperature rise is a problem. By attaching the sensor to the battery, the charger can be controlled by the temperature switch.

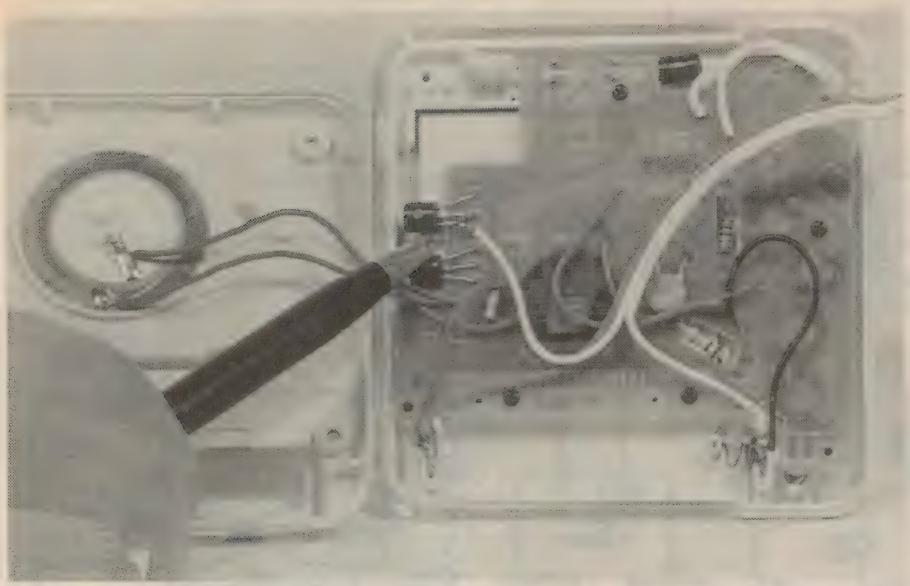
The complete device consists of the Temp Alert dual digital electronic thermometer, connected to an adaptor unit which does the actual mains switching. The adaptor is built into a low cost plastic instrument case and is connected to the thermometer by three wires, via a 3.5mm stereo phono plug and socket (or only two wires if the thermometer is to be powered by its own internal non-rechargable battery). The use of a plug and socket allows the thermometer to be disconnected and used independently of the adaptor if required.

CAUTION: Mains wiring!

This adaptor involves live mains wiring, so it is very important to follow the assembly instructions carefully in every detail, to ensure that it is safe to use.

The adaptor unit has a mains cable and plug for connection to a general purpose mains outlet, and a panel-mounted mains socket on its case for plugging the heater or other controlled device into. A relay is used as the power switching device, which can control 240V AC loads of up to 7.5A.

An opto-coupled triac circuit was originally going to be used for the purpose, which would have provided superior isolation between the mains and the low voltage circuitry; but the case used for the adaptor is not large and does not



In this photo of the inside of the thermometer, the pen is pointing to the transistor collector where one of the leads for the adaptor must be connected. The other two leads are connected to each of the battery clips.

have a metal panel to conveniently use as a heatsink for the triac. The relay also has the advantage of less complexity and fewer associated components.

The appeal of the particular electronic thermometer used here is that it has a large, easy to read, dual three-digit display (one display for the internal sensor temperature and the other for the external sensor temperature) giving a temperature resolution of 0.1 degree, and it can also be programmed to give an alarm under the following four different conditions (for the external temperature sensor only):

(a) if the temperature falls below a set threshold.
(b) if the temperature rises above a set threshold.
(c) if the temerature is within a set temperature range or 'window'.
(d) if the temperature is outside a set temperature window.

When the thermometer alarm is triggered, it gives five short audible tone bursts — once every minute — until the temperature returns to within the non-alarm limit(s).

In the work to develop a matching power switch adaptor, the thermometer's PCB was searched for an accessible continuous alarm signal — i.e., one that stayed on whenever an alarm condition existed; or even for a signal which distinguished between high and low temperature alarms.

But the only signal found was the actual intermittent tone bursts, which are used to drive the thermometer's piezoelectric speaker and the two LED's. And so the adaptor was designed to make this intermittent alarm signal operate the relay, and hold it on during the one minute intervals between the alarm sounds.

A view of the circuitry which normally fits inside the switching adaptor itself. Virtually all of the components fit on a small PC board, apart from the three pin output socket. The indicator LEDs protrude through holes in the front panel.

The adaptor is designed to supply power (1.5V) to the thermometer without the need for installing the thermometer battery, or alternatively to trickle charge a NiCad battery. However, a non-rechargable battery can be installed in the thermometer by leaving the power wire from the adaptor disconnected. This option also allows the use of a light twin cable between the adaptor and the thermometer, instead of a thicker and more expensive three-wire cable. Also a carbon-zinc or alkaline battery is less expensive than a NiCad.

The use of a battery is advisable, so that in the event of a power failure the temperature alarm settings will not be lost, and normal operation will be resumed when the power is restored.

By the way, as you might expect Dick Smith Electronics has retained copyright on the PCB design for this project — after all, they *did* develop the project. This means that boards cannot be produced and sold by other firms, although individual contructors may make their own if they wish.

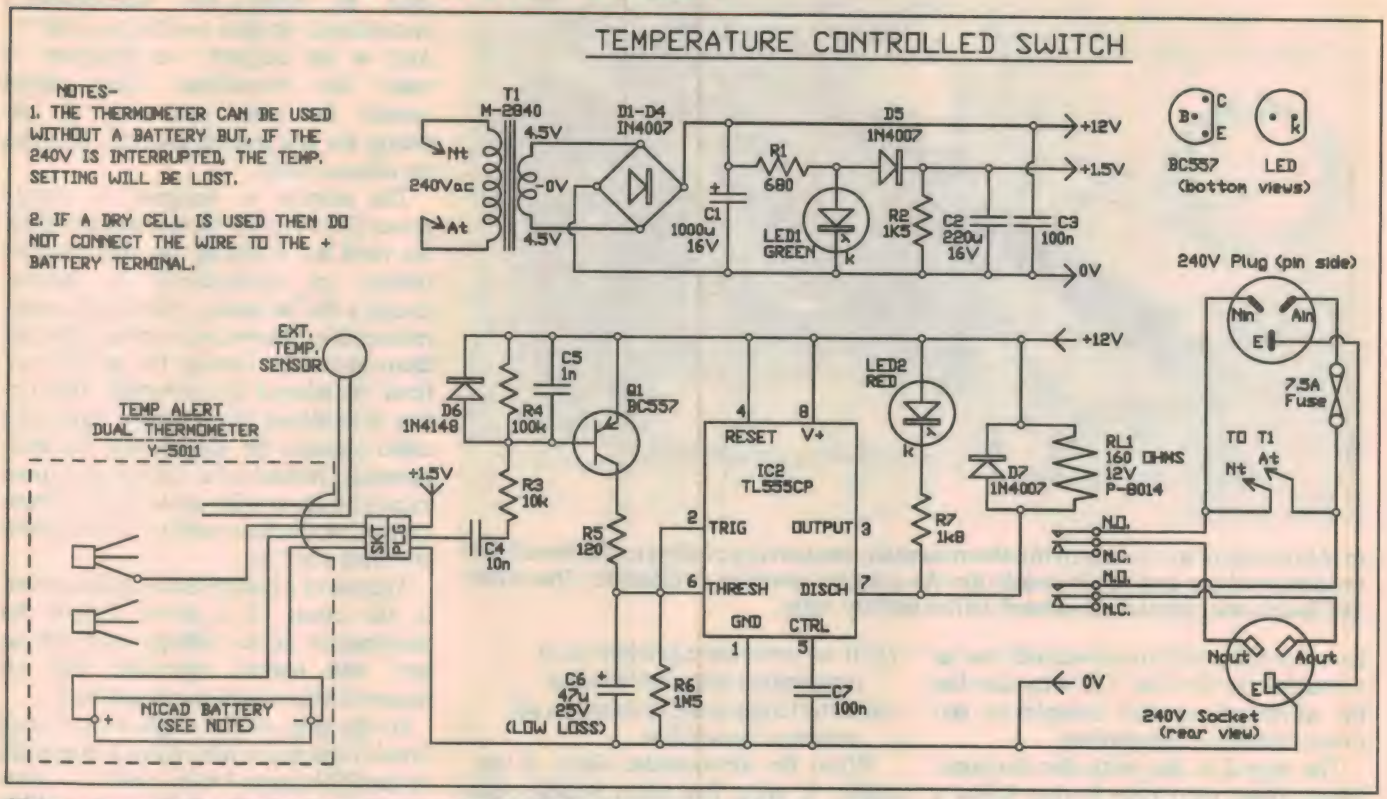
Dick Smith Electronics itself will of course be selling a complete kit for the project, to make building it as easy as possible. The kit will carry the catalog number K-3130, and is priced at $99.00 — which includes the digital thermometer unit as well as everything you need to make up the complete project. The front and back panels of the case are even pre-punched and silk-screened.

How it works

The signal from the thermometer consists of tone bursts of about +3V peak, with respect to the negative terminal of the thermometer battery. This signal comes from the collector of a transistor which is used to flash the red and green LEDs in the thermometer. The signal return path is to the negative terminal of the battery socket. The optional third wire between the thermometer and the adaptor connects to the positive terminal of the battery socket, to provide power to the thermometer and to trickle charge the NiCad battery if one is used.

In the adaptor the alarm signal is coupled via a DC isolation capacitor C4 and current limiting resistor R3, to the base of transistor Q1. Diode D6 clamps the positive peaks of the signal to 0.6V

Temperature controlled switch



This schematic for the temperature control switch shows everything, including the connections inside the thermometer unit. As you can see, a relatively small number of components are required.

above the positive supply potential and resistor R4 ensures that the transistor turns off in between the pulses. C5 was found to be necessary to prevent high frequency noise from interfering with the circuit operation.

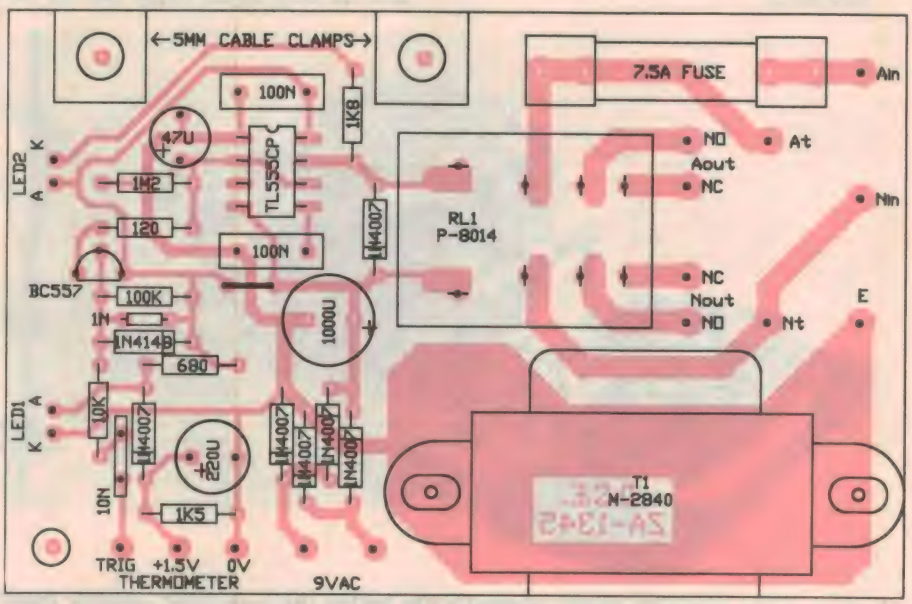
The alarm signal causes Q1 to turn on, and this charges C6 to the positive supply voltage. This in turn triggers the 555 timer, which turns on the internal open-collector 'discharge' transistor at pin 7. This is used to operate relay RL1, and also turn on LED2.

When the alarm signal stops, capacitor C6 begins discharging through resistor R6. If another alarm signal does not occur within about 80 seconds, then C6 eventually discharges to 1/3 the positive supply voltage, at which point the 555 switches off the discharge transistor at pin 7. RL1 and LED2 then switch off. Of course if another alarm signal does arrive from the thermometer, this turns on Q1 again and C6 is re-charged up to the supply voltage, keeping the 555 switched on and the relay continues to operate.

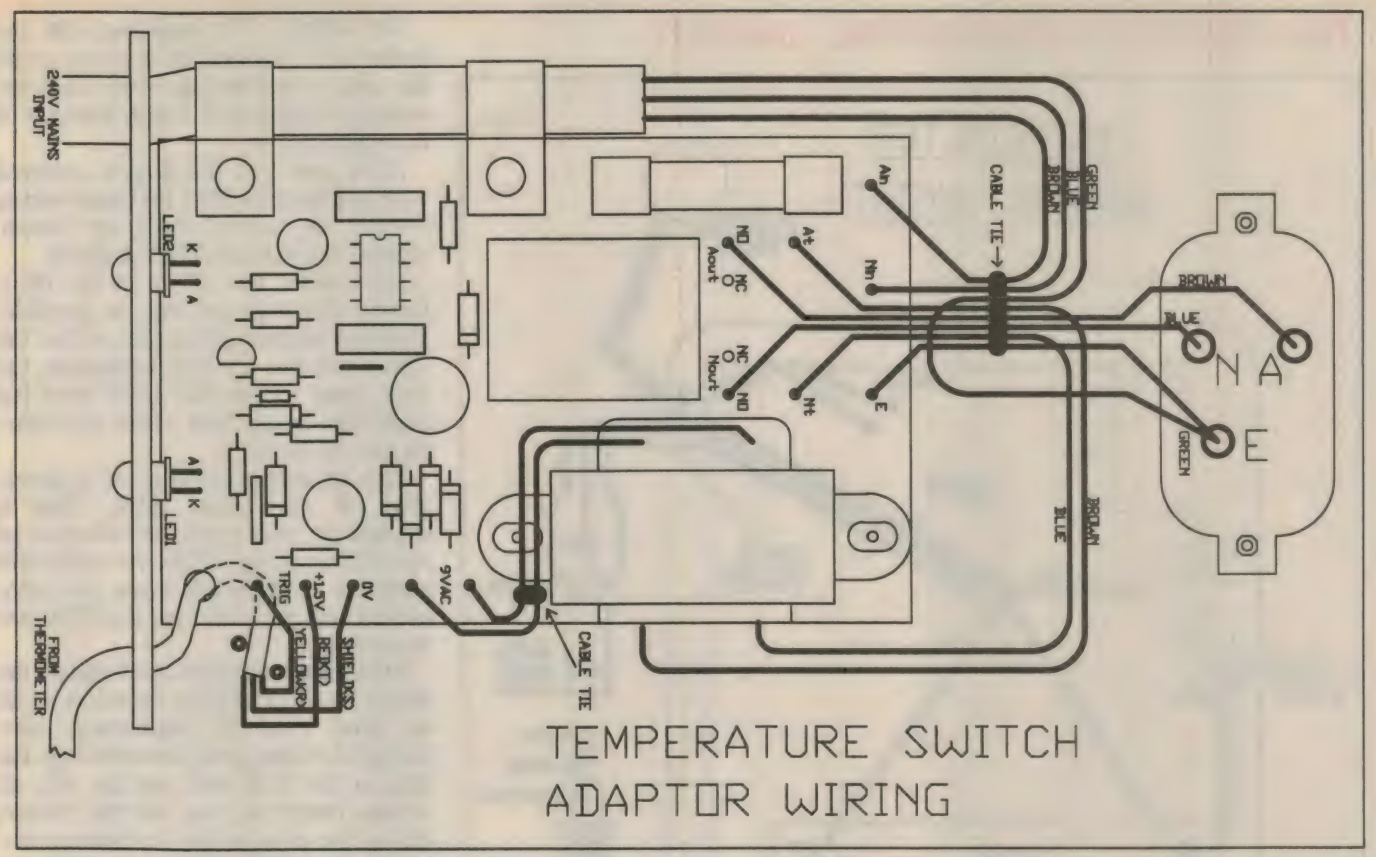
Relay RL1 has both normally closed (NC) and normally open (NO) contacts available for connection to the adaptor mains socket. If the socket is wired via the NO relay contacts, then the 240V is switched to the socket when the thermometer's alarm 'goes off', while if the NC contacts are used then the 240V is disconnected from the socket when the alarm goes off.

The supply voltage used by the adaptor circuit is 12V DC, which is provided from the mains via stepdown transformer T1, a bridge rectifier consisting of discrete diodes D1-D4, and filter capacitors C1 and C3. When the relay operates, this voltage drops to around 10V — which is still adequate to keep the relay operated.

The thermometer unit itself requires 1.5V DC, which is supplied by R1, LED1, D5, R2 and C2. LED1 serves two purposes, one of which is to indicate that power has been applied to the circuit. The second is to act as a voltage regulator,



Use this overlay diagram as a guide when you are fitting all of the smaller components to the PC board.



Use this diagram to guide you in making the connections between the PCB and the various leads and larger components.

with a fairly constant forward voltage drop of 2V. Diode D5 reduces this to the required 1.5V. R1 provides current limiting for both LED1 and the NiCad battery (if used).

Resistor R2 biases D5 to keep the 1.5V constant, despite the wide range of current drawn by the thermometer: between about 4uA and 80uA when the alarm is off, rising to a peak of about 7mA when the alarm is sounding. This regulation is needed because the temperature reading varies by almost -0.1° for a +0.1V change in the supply voltage.

C2 stops the 1.5V supply from dropping below the minimum operating voltage of the thermometer during the alarm pulses, which would otherwise make the display flash and corrupt the alarm settings. R2 produces a 1mA drain from the NiCad battery if the mains power fails, but this is not enough to flatten a charged battery provided that power is restored within a few days.

PARTS LIST

Resistors

All 1%/0.25W metal film unless otherwise stated:

R1	680 ohms
R2	1.5k
R3	10k
R4	100k
R5	120 ohms
R6	1.5M 5%/0.25W carbon film
R7	1.8k

Capacitors

C1	1000uF/16VW RB electrolytic
C2	220uF/16VW RB electrolytic
C3,7	0.1uF ceramic
C4	10nF ceramic
C5	1nF ceramic
C6	47uF/25VW low loss RB electro

Semiconductors

D1-5,7	1N4007 rectifier diode
D6	1N4148 signal diode
LED1	5mm green LED
LED2	5mm red LED
Q1	BC557 PNP transistor
IC1	TL555CP (CMOS 555) timer IC

Miscellaneous

T1	Power transformer 240V/9V CT at 150mA
PLG1	240V/7.5A moulded plug & cable
SKT1	Flush mount 240V mains socket
F1	7.5A 3AG fuse
RL1	12V relay - 240V/10A contacts

'Temp Alert' dual electronic thermometer (DSE type Y 5011); plastic instrument case, 95 x 145 x 45mm; PC board, 99 x 65mm, code ZA-1345; two 3AG fuse clips, PCB mounting type; two 5mm cable clamps; four 3mm bolts,9mm long; six 3mm nuts; six washers for cable clamps; two star washers for power transformer; two nylon cable ties; five PCB pins; 2m length of twin core shielded cable; 3.5mm stereo line socket; 3.5mm stereo line plug; 200mm length of ribbon cable.

If a flat NiCad battery is installed in the thermometer, then both the LCD display and LED1 will not come on until the battery voltage rises to about 1.1V.

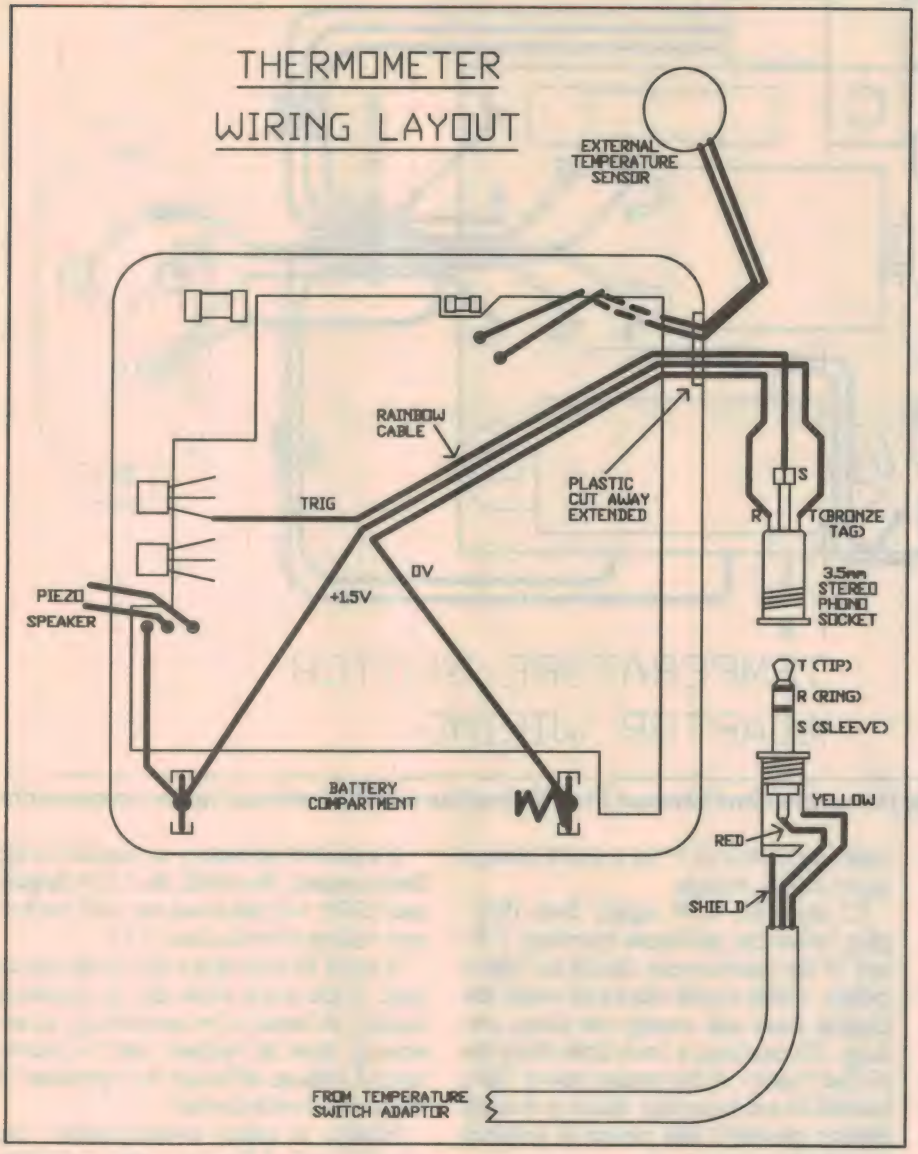
A point to note about the thermometer unit: if the noise from the piezoelectric speaker is found to be unnecessary or annoying, then the speaker can be disconnected without effecting the operation of the power switch circuit.

Finally, a safety consideration. The negative rail of the low voltage circuitry has been connected to the mains earth. So that if the active mains wiring should come adrift inside the adaptor, and touches the low voltage circuitry, then the fuse will blow or an earth leakage detector will be tripped (if one has been installed in the mains supply).

Construction

The first thing that should be done is to cut off the four plastic mounting posts (two on each half of the case) from the inside of the case, before beginning construction. They are not used in this project, and will interfere with the PCB mounting. Virtually all of the adaptor circuitry mounts on a small PCB, measuring 99 x 65mm and coded ZA-1345 (copyright DSE).

When mounting the components on the PCB, follow the diagrams closely so that the components are mounted in



If you're still not quite sure about the connections to the thermometer unit, this diagram should make everything clear. It even shows the 3.5mm plug and socket wiring. Note that the plastic case is cut away for entry of the additional cable.

the correct direction as well as in the correct location.

Begin construction by mounting and soldering all the low profile components, such as the resistors and diodes. Then fit the IC, transistor, capacitors, fuse clips and PCB pins, starting from the smallest components and working up to the largest. Leave the LED's until last, so that they don't get bent around too much during construction.

Mount the relay next, but before soldering the pins, bend the pins over onto the pads that they will be soldered to, while keeping the relay pressed firmly against the PCB. Don't leave a large gap between the relay pin and the PCB pad and attempt to bridge the gap with a large blob of solder.

Mount the power transformer with star washers between the head of the mounting bolts and the PCB, to ensure good contact. Solder the primary and secondary wires to the PCB, leaving a small loop of excess in each wire in case the wires have to be cut and reterminated.

With a length each of brown, blue and green mains wire, connect the mains socket to the PCB. Normally the active and neutral wires from the socket will be connected to the NO contacts of the relay, so that the power is off until the thermometer gives an alarm. Connect the piece of earth wire to the PCB, but leave it out of the socket until the mains cable is installed, because the mains cable's earth will be twisted with the PCB earth wire inside the socket earth terminal.

For safety it is important that the mains earth is connected as shown, with the earth wire from the mains lead terminated directly in the earth terminal of the mains socket.

Make sure that the correct coloured wires are used for all of the mains wiring — i.e., all 'active' wires are brown, 'neutral' are blue and 'earth' is green.

Now solder the LED's to the PCB, leaving the leads as long as possible. Bend the leads at right angles, so that the LED's will line up with the holes in the front panel — but DO NOT bend the leads right at the point where they enter the base of the LED.

Strip as much sheathing as is necessary off the mains cable, feed it through the front panel, and clamp it to the PCB as shown. Solder the active and neutral to the PCB and screw the earth, twisted with the earth from the PCB, into the socket.

At this stage carefully check that all the wiring is correct and that the solder joints are good. Feed the thermometer wire through the front panel, down through the hole in the PCB and out the side as shown. Install the unit into the bottom half of the case so that the thermometer cable comes out between two plastic posts as shown. Solder the thermometer wires to the PCB pins.

When all of the adaptor wiring is completed, place cable ties on the wires as shown in the diagrams. This is to prevent mains wires from coming into contact with the low voltage circuitry in the event of a wire breaking loose.

Finally, place the top half of the case in position and then you're ready to do the wiring to the thermometer.

Thermometer wiring

Remove the four screws and take off the rear half of the thermometer case, taking care not to strain the wires to the speaker. Then using a knife or side cutters, extend the slot through which the external temperature sensor wires pass so that there is enough room for a two or three-wire ribbon cable to pass through. (We'll assume you'll be powering the thermometer from the adaptor, or using a NiCad cell, in which case you'll need to fit the three-wire cable; otherwise, use a two-wire cable.)

Now take a suitable length of three-wire ribbon cable and solder it to the three points inside the thermometer as shown in the wiring diagram. Lay the cable as flat as possible so that the two halves of the case will come together again properly. You should then be able to re-assemble the case, and re-fit the four screws.

Solder the other end of the cable to the

stereo phono socket, taking care not to leave any free strands of wire that might short circuit the battery.

Testing

Leave the thermometer disconnected from the adaptor for the time being. Plug the adaptor into the mains and check that the green LED is on and the red LED is off.

Using a multimeter, check that there is 1.5V between the tip (+) and sleeve of the phono plug (unless the power wire is being left off, because you're going to use a non-rechargable cell in the thermometer).

Plug a 240V lamp into the adaptor mains socket. If the socket has been wired to the NO relay contacts, then the lamp should be off. If the socket is wired to the NC contacts, then the lamp should be on. Now connect the thermometer to the adaptor, set the ALERT/TEMP switch to TEMP, and check that the thermometer is displaying the internal and external temperatures properly. Make a note of what the external temperature reading is.

Set the ALERT/TEMP switch to ALERT. Repeatedly press ALERT SELECT until the high temperature alert (up-arrow) symbol is shown in the top display. Press HIGH SET until the temperature shown is just one or two degrees above the external sensor temperature. Press ALERT ON/OFF so that the ALERT message appears on the display (this means that the alarm is set to go off if the temperature of the external sensor goes above the set temperature).

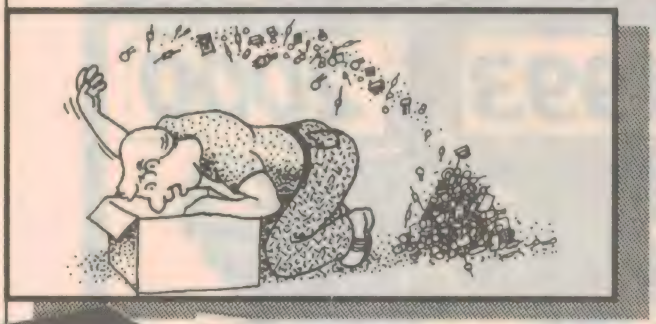
Set the ALERT/TEMP switch back to TEMP. If the external temperature is still less than the set temperature then the alarm will not go off. Now heat up the external sensor (breathing on it might do the trick). As soon as the sensor temperature reaches the set temperature, the thermometer should beep and its two LED's should flash. The red LED on the adaptor should also come on, indicating that the relay has operated. The lamp plugged into the adaptor socket should turn on as well (or off, if the NC contacts were used).

Keep the temperature of the sensor above the set temperature, and check that the red LED on the adaptor does not go out at any time (i.e., while the thermometer keeps on registering the alarm state). Then reduce the sensor temperature below the set temperature, and check that both the red LED and your 240V lamp go out after about 80 seconds.

That's all there is to it, and your temperature-controlled power switch should now be ready for use. (J.R.) ❖

DICK SMITH ELECTRONICS

MORE NEW KITS!



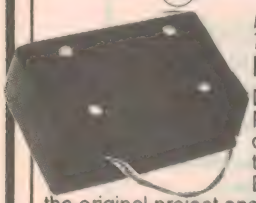
Automatically Controls Temperature

NEW

TEMPERATURE CONTROLLER SWITCH

An ingenious kit that proves very useful for many applications such as: Ovens, room temperature control, fish tank heaters, animal enclosure heaters or cooling devices utilizing fans and water pumps. With a maximum allowable load of 7.5 Amps (1800 VA), the temperature controller automatically switches the power on or off when the temperature goes above or below a set threshold. The project utilises our existing Y-5011 dual display digital thermometer which comes complete with internal and external temperature sensors and it can be programmed to sound an alarm if thetemperature falls below a certain threshold or rises above a certain threshold. The kit comes in full form with all components, hardware, digital temperature module, deluxe case, flush mount mains socket, pre-punched screened front panel and pre-punched rear panel.

EA AUG '93 Cat K-3130 **$99**



Increases The Range Of The Light Beam Relay Kit

NEW

Light Beam Extender

Designed to go with our existing Light Beam Relay project (K-3120). It monitors paths or doorways using an infrared light beam which triggers an alarm when the beam is broken. By disabling the internal transmitter circuit of the original project and using the Light Beam Extender in its place, you can have a greater range or move to another location with ease. It uses a 555 timer IC and a transistor to pulse two IR LED's at a frequency of about 2kHz and effectively increases the working range to about 5 metres - two and a half times the original. Comes complete with all components, hardware including an IC socket for the 555 timer, PCB and a mini zippy box to house your project.

SILICON CHIP JUL '93 Cat K-3122 **$9.95**

Gearing up For Winter!

Digital Voltmeter For Cars

Your car's battery is the most likely component to fail during the winter months. With this digital voltmeter, you can see how your car's battery is faring in order to avoid all the hassles that come with a flat battery. Using an older, but far more economical circuit technique than most digital voltmeters, it accurately measures the battery voltage over an 8 to 17 volt range and displays the result on a 3-digit LED display with 0.1V resolution. If the battery voltage is less than 12V, then either the charging system is not working correctly or the battery is dead! The voltmeter also tells you if the battery is being over charged, helping you to avoid damage to both your battery and electrical system. Comes in full form with all components, PCB, case, front panel label, digital displays and perspex window. Also a satellite PCB is supplied in Dick Smith Elecronics kits if you wish to mount the displays remotely.

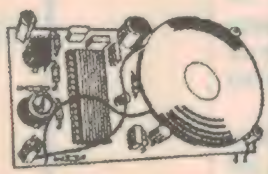
SILICON CHIP JUN '93 Cat K-4208 **$39.95**

Quality Home Movie Editing

LOW-COST COLOUR VIDEO FADER

You can solve all your messy editing problems once you build this colour video fader! Now you can make clean edits from one scene to the next on your VCR without having to buy a top-of-the-line model! The video fader accepts any colour or black and white composite PAL video signal and can fade it smoothly down to a black screen and back up again, providing you with a professional transition from one scene to the next. Plus, it lets you create special effects with its additional "wipe screen" facility. Comes complete with all components, PCB, hardware including easy-to-mount one hole 2.1mm DC socket, zippy box, IC sockets, front panel and case side labels.

SILICON CHIP AUG '93 **NEW** Cat K-5410 **$32.95**



Easy to build, Easy To Use!

Message Recorder

Now, there's no need to frantically search for a pen every time you want to leave a message for someone! Build this kit and record your important messages electronically. Using a single chip, it records voice messages up to 16 seconds and retains them even through power failures. Incorporate the message recorder in your own designed projects, so instead of receiving a beep or having a flashing LED as a warning indicator, your pre-recorded message will alert you. It's an easy-to-use kit with two-button operation. Comes in short form, with all components, PCB, hardware including speaker and mic insert.

SILICON CHIP JUL'93 Cat K-5018 **$39.95**

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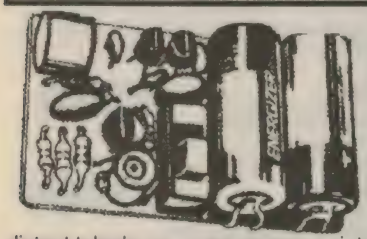
Signal Checker

Now you can build your own simple, cost-effective signal checker! Without being as complex as traditional models, this compact version can compare circuits point by point. If you have a faulty board and a good board for comparison, you can easily find the bad components that are out of spec and repair the board. The Signal Checker integrates the magnitude of the difference between the signature of a good component to that of a bad one and displays it on a meter reading. Operated by one 9V battery (not included), it comes in full form, with all components, hardware bits, panel meter, PCB, zippy box, pre-punched silk-screened front panel and test probes.

EA AUG '93 Cat K-7226 **$39.95**

Please contact your nearest store for availability as some kits may still be in production.

FOR BOTH THE HOBBYIST AND THE SERVICEMAN!



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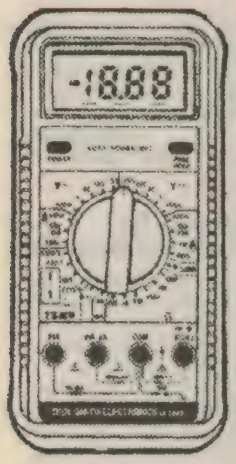
Teaches you, your kids or your students the basic principles of how a superheterodyne radio works. It's built with easy-to-get parts and everything is mounted on a single PCB with the circuit diagram screened onto the component side of the PCB, so assembly is a breeze. Supplied with all components, PCB and hardware.

SILICON CHIP JUL '93 Cat K-5016 **$39.95**



Bonus Carry Case!

3.75 Digit (4,000 Count) Multimeter Complete With Holster

A rugged meter that's great for both field and workshop use, it's shock resistant and comes with a rubber holster for maximum protection. It's supplied with a thermocouple probe for temperature measurement from -40°C to 260°C and protective holster. The meter features most standard ranges plus: Continuity, diode, logic, frequency (auto-ranging), temperature, peakhold and auto power-off.

Cat Q-1542

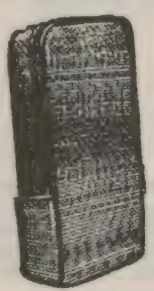
$179

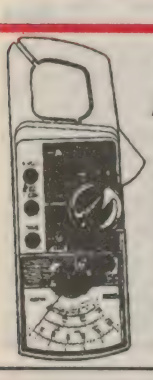
Ranges:

DC V: 400mV, 4V, 40V, 400V, 1000V
AC V: 400mV, 4V, 40V, 400V, 750V
DC Current: 400uA, 4mA, 40mA, 400mA,20A
AC Current: 400uA, 40mA, 400mA, 20A
Resistance (ohms): 400, 4K, 40K, 400K, 4M, 40M
Frequency (auto-ranging): 4KHz, 40KHz, 400KHz, 4000KHz,
Temperature: Thermocouple supplied: -40° to 260°
(Unit's range: -50° to 1300°C)

***BONUS CARRY CASE** (Q-1992)

VALUE $14.95





With 34mm Jaw

Analogue Clamp Meter

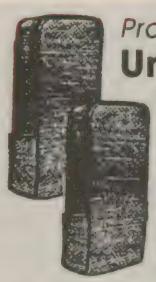
A versatile, 11-range multimeter for measuring AC current, AC voltage, resistance plus DC voltage. With pointer lock device to freeze reading and large 34mm measuring jaw. It includes a wrist strap for single-handed use, test leads, instructions and a protective carry-case.

Cat Q-1472

$89.95

Ranges:

AC Current: 6, 15, 60, 150, 300A
AC Voltage: 150, 300, 750V
DC Voltage: 75V
Resistance: x1, x100 ohms



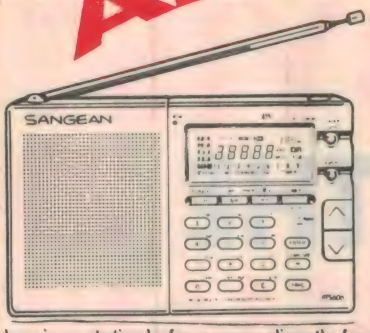
Protect your Multimeter!

Universal Carry Case

These carry cases can provide a degree of protection not only to your multimeters but to many others items such as: Small portable radio/cassette players, microphones, small handheld CB's and scanners, tools and more! They're made from vinyl with zip-up sides and soft inside lining for added protection and are fitted with either a carry loop or clip (depending on the size) so that they can be carried with ease.

Med/Black Cat Q-1990 **Large/Grey** Cat Q-1992 **$14.95 ea.**

THE BEST RADIO GEAR AROUND!



Compact 45-Memory Shortwave Receiver

Auto-Tuning Makes It Incredibly Easy To Use!

Listening to the world on shortwave radio has never been easier! The super-compact ATS-606 scans through the bands for you or it will locate and put the nine strongest signals on both the AM and FM bands into memory. You can also key in a station's frequency directly from the keypad or put up to 45 frequencies into memory for instant push-button access. It gives continuous shortwave coverage from 1.715-29.995MHz, and 13 international SW band divisions can be directly accessed at the touch of a button. There's an informative back-lit LCD screen showing frequency and time with a variety of icons to indicate the functions being accessed. You also get a dual alarm clock, sleep timer, dual time settings so you can pre-set any two time-zones, DX/local switch which allows you to set the sensitivity to suit differing conditions, plus a lock switch to prevent accidentally changing stations. Comes with stereo earphones for FM stereo operation and has an antenna socket for connection of an external antenna. Requires 3 x AA batteries.

SANGEAN

Features:
- Automatic tuning system
- 45 station memories
- Comprehensive LCD screen
- Scan tuning & direct keypad tuning
- Dual alarm clocks
- Dual time setting
- Adjustable sleep timer

Frequency ranges:
FM: 87.50-108MHz
LW: 153-513kHz
MW: 522-1710kHz
SW: 1.715-29.995MHz
Includes 13 pre-set shortwave bands

Cat D-2847 **$249**

Shortwave listening Guide

The whole world's talking on shortwave radio and this book tells us how to listen in! This amazing book tells you everything you need to know about shortwave: Selecting the right shortwave radio, how reception conditions vary, how to operate a shortwave radio correctly, profiles of international stations and more!

Cat B-2040 **$29.95**

Reel-Style Antenna

Portable Shortwave Antenna

The Sangean ANT-60 is a wind-up reel-style antenna that extends to a full 7 metres (23 feet), yet fits in a shirt pocket! It connects via a 3.5mm mini plug or the supplied adaptor that clips onto your portable's telescopic antenna.

SANGEAN

Cat D-4400 **$19.95**

SAVE $5

World Radio And TV Handbook 1993

The ultimate directory of international radio and television considered by SWL enthusiasts as the "bible" for shortwave listening. Gives complete listings including frequencies, addresses, call signs station identification and transmission times. There's even a special feature on how to convert local time against UTC.

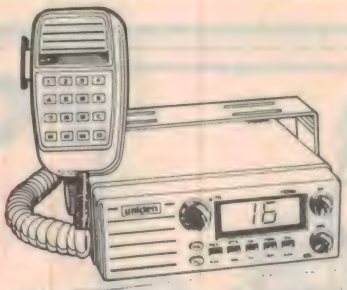
Cat B-2093 **$34.95**

SAVE $5

Passport To Worldband Radio '93

This book is imperative for anyone who's getting started with a shortwave receiver. It's the latest 1993 edition and it includes all the changes that have taken place in Europe and Russia. If you want to know what's on shortwave radio, the best and worst radios, how to get the most from your shortwave listening and more, it's all here.

Cat B-2052 **$34.95**



Uniden 55-Channel VHF Marine Transceiver

With Direct-Dial Seaphone Microphone!

The MC-950 25-watt VHF transceiver covers 55 Australian and international channels, and boasts a superb array of features for outstanding performance. It's supplied with Uniden's Auto Seaphone-compatible microphone which allows you to make telephone calls from your boat once you're registered with OTC. The microphone provides push button dialling with a backlit keypad, 10 number memories, last number redial, keypad confirmation tones, and DTMF overdialling. The MC-950 uses a front-panel speaker for clearer audio, and the LCD screen has four brightnesss for easy day or night viewing. There are scanning modes (normal, timed, memory, group) for quickly locating active channels, plus pushbutton selection for emergency channel 16. Other features include: Dual-watch, PA facility (requires optional speaker), selectable 25w/1w output and a weather-resistant plastic housing with simple mounting hardware.

2 Year Warranty

Specifications:

RF output power:	25W/1W
Receiver sensitivity:	0.25uV (12dB SINAD)
Audio Output:	4 Watts
Operating Voltage:	13.8VDC nominal
Current drain:	0.2A Standby
	4.5 (25W output)
Size:	163(W) x 56(H) x 203(D)mm

uniden

Cat D-1730 **$369**

VHF Marine Antenna

Get Top Quality Reception From Your VHF Marine Transceiver!

This compact antenna covers the VHF marine band with less than 1.5:1 SWR. Power rating is 25 watts and it provides an omni-directional transmission pattern. A sturdy swivel deck mount is supplied, along with 3.6m of coax and a PL-259 plug. Ideal for the Uniden MC-950 transceiver listed above.

5 Year Warranty

Cat D-4014 **$59.95**

MAJOR DICK SMITH ELECTRONICS AUTHORISED STOCKISTS

NSW ARMIDALE: New England Electronics 71 1655 **BALLINA:** Ballina Electronics 86 7022 **BATEMAN'S BAY:** Baycity Sight & Sound 72 5030 **BATHURST:** Electronic Frontiers 32 3933 **BOURKE:** Countrywide Services 72 2150 **BOWRAL:** Bowral Electrical Suppliers 61 1861 **BROKEN HILL:** Hobbies & Electronics 88 1498 **COOTAMUNDRA:** Cootamundra Music & Light 422561 **COFFS HARBOUR:** Coffs Harbour Electronics 525 684 **DENILIQUIN:** Deni Electronics 813672 **DUBBO:** Chris's Hi Fi 828711 **GOULBURN:** Tunlive 221288 **GRAFTON:** Repairs & Spares 421911 **GRIFFITH:** Miatronics 624534 **INVERELL:** Inverell Electronics 221821 **KATOOMBA:** Niagara Photo & Sports 822800 **KEMPSEY:** P & K Richards 631134 **LEETON:** Leeton Audiotronic 532800 **LIGHTNING RIDGE:** Lightning Ridge Solar Power 291013 **LISMORE:** Decro Electronic Services 214137 **LITHGOW:** Douroy Photographics 513173 **MACKSVILLE:** Macksville Electronics 682 899 **MOREE:** Moree Electronics 522091 **MUDGEE:** Headwear 723895 **MURWILLUMBAH:** Strings & Things 723 684 **NARRABRI:** Namoi Computer Service 923274 **NELSON BAY:** Nelson Bay Elect. & Hobbies 813685 **NOWRA:** Nowra Electronics 210722 **PARKES:** Strad Music Centre 623366 **RICHMOND:** Silicon Crafts 784101 **TAREE:** Manning Electronics 512233 **TUNCURRY:** Tuncurry Electronics 545006 **ULLADULLA:** Coastal Electronics 553989 **WAGGA WAGGA:** Phillips Electronics 216538 **WALGETT:** Walgett Electronic Centre 281111 **WINDSOR:** Hawkesbury Electronics 776722 **YASS:** Warmington Electrical 261411 **YOUNG:** Keith Donges 821279 **VIC ARARAT:** Jerram Electronics 522345 **BAIRNSDALE:** Green Gage Services 525677 **BENALA:** North East Electronics 622710 **CASTLEMAINE:** Inspect Electrics 723773 **COLAC:** Colac Electronics 312847 **ECHUCA:** Gillmour Electronics 822956 **MILDURA:** Pullman Auto Pro 232882 **MORWELL:** Roylaine Pty Ltd 339458 **ROSEBUD:** Seatech Vic Pty Ltd 822225 **SHEPPARTON:** Andrew Guyatt Electronics 219497 **SWAN HILL:** Nyah District TV Service 329303 **ST. ARNAUD:** Whartons Appliances 951069 **WARRAGUL:** Roylaine 234255 **WARRNAMBOOL:** Koroit St. Elect. Services 627417 **WONTHAGGI:** South Gippsland Photo Service 721411 **QLD AYR:** Delta Electrix 831566 **BLACKWATER:** Cool Tronics 825827 **BOWEN:** Plaza Electronics 863477 **BUNDABERG:** Bob Elkin Electronics 521785 **CALOUNDRA:** Electro-mart 918533 **DALBY:** Hobby & Electronics 625770 **EMERALD:** Cooltronics 825222 **GLADSTONE:** Electronic Enterprises 726660 **GOONDIWINDI:** CTW Electronics 713411 **INGHAM:** Masons Electronics 763188 **INNISFAIL:** Innisfail Hi-Fi 612014 **KINGAROY:** MD & MM Siegle 624535 **MACKAY:** Steven's Electronics 511723 **MARYBOROUGH:** Keller Electronics 214559 **MOSSMAN:** Mossman Electronics 982200 **MT. ISA:** Outback Electronics 433331 **NAMBOUR:** Nambour Electronics 411966 **PIALBA:** Keller Electronics 283749 **STANTHORPE:** Granite Belt Communications 813333 **TAS BURNIE:** Electronic City 314 760 **DEVONPORT:** Al Electronics 248322 **SA MT. GAMBIER:** Hutchesson's Communication 250400 **PORT LINCOLN:** Basshams TV & Comp. World 830075 **WHYALLA:** Eyre Electronics454764 **WA ALBANY:** Micro Electronics 412077 **BUNBURY:** Micro Electronics 216222 **COWARAMUP:** CPA Electronics 555448 **GERALDTON:** Angora Lighting 211278 **MANDURAH:** Mandurah Hi Fi 5812206 **MARGARET RIVER:** CPA Electronics 573888 **PORT HEDLAND:** Ivan Tomek Electronics 732531

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Butane Soldering Iron

Four fantastic tools in one!

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NIMROD

This amazing pocket-sized butane powered soldering iron is built to last and has fully adjustable temperature control (400-1300°C). Plus, with the optional tips you can turn it into a handy blow torch, hot knife and hot air gun. There's also a transparent gas level window so you won't run out in the middle of a job. You'll also find that, because of its unique tip design, replacement tips are relatively inexpensive.

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NEW

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Resistor For Ethernet Systems

A male BNC plug with 50 OHM resistance suitable for terminating unused outlets in ethernet networking systems. Has nickel on brass construction with a gold centre pin plus teflon/rubber gaskets for durability and low loss. Resistance value is stamped into the body of the terminator for clear identification.

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All-purpose Alarm Lock Cable

Hundreds Of Uses!

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Secure your trailer, bike, boat, gate or anything mobile or portable with this reliable alarm lock cable! You'll feel safe knowing that it will sound an extra-loud 110dB siren if any attempt is made to tamper with your lock. It includes: 6 feet of extra strength steel wire cable, vibration sensor switch, two security keys, mounting bracket and a high-impact weatherproof case. Comes complete with three months warranty.

NEW

Male BNC To Twin Female BNC 'T' - Type Adaptor

Enables two BNC male plugs to be joined to a single BNC female socket. Nickel on brass (not zinc) with a gold centre pin.

Cat P-2275 **$5.95**

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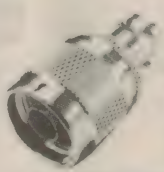

BNC Female To N-Type Adaptor

This adaptor allows for standard test equipment using BNC connectors to be connected to N-typed products, specifically in RF applications. Features a nickel on brass construction with gold centre pin.

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NEW

Mastering Solid State Amplifiers

A well-presented, well-written and practical self-study course on solid-state amplifiers. Combines theory, practical experiments and projects to give you a full working knowledge of component specifications, design standards and applications. It's packed with illustrations to make mastering amplifier technology easy.

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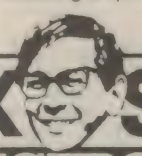

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Construction Project:

SIGCHECKER: SIMPLEST SIGNATURE ANALYSER YET!

This simple instrument can compare circuits point by point. If you have a faulty board and a good board for comparison, you can easily find the bad components and repair the board. There is no need to understand circuits, nor even to have any diagrams. If you are a circuit trouble shooter, you'll like this one.

by STEVE REICHARD

I have lived a long time designing, mending and re-designing electronic circuitry, and I have developed a vision of heaven where everything has a correctly updated schematic and a complete operating description in good basic English engraved on the inside of its cover.

While I hope to go to that heaven one day, I am still cursed with living in a world where more and more electronic devices come without any information at all, or have operating and service pamphlet translated from Japanese, Chinese or German by some first year Arts and Language student.

Along with other people, my 'non electronic' friends buy such gadgets and then I get asked to 'please look at it, it doesn't work'. If I say that I have very little chance of reviving it without a circuit diagram, I come close to losing a friend.

To avoid such difficulties, I have learnt to behave like a medico rather than an engineer. After all, medics do not find circuit diagrams or data sheets tucked into their patients' pockets, nor can they write to the manufacturer for a service manual. And yet they often manage to do the right thing and reap rich rewards of money, status and friendship.

The reason for their success is that they do not insist on understanding all the intricacies of the hardware and software. Instead, they take a good working model, and compare it node by node with the sick one.

When they find the node with the greatest discrepancy, they replace all the components around the bad node with new or good second-hand spares, remake all the connections as best they can and keep repeating the process until either the patient is cured, or runs out of money, or they find that the model is past its use-by date and spares are no longer available!

In electronics the same approach can also bring good results, but there is an ideological hurdle.

As properly trained engineers, we cannot accept the rather loose understanding of what we are doing and we have therefore invented a scientific sounding name for what down-to-earth people would call the 'idiot approach'. It is called *signature analysis*.

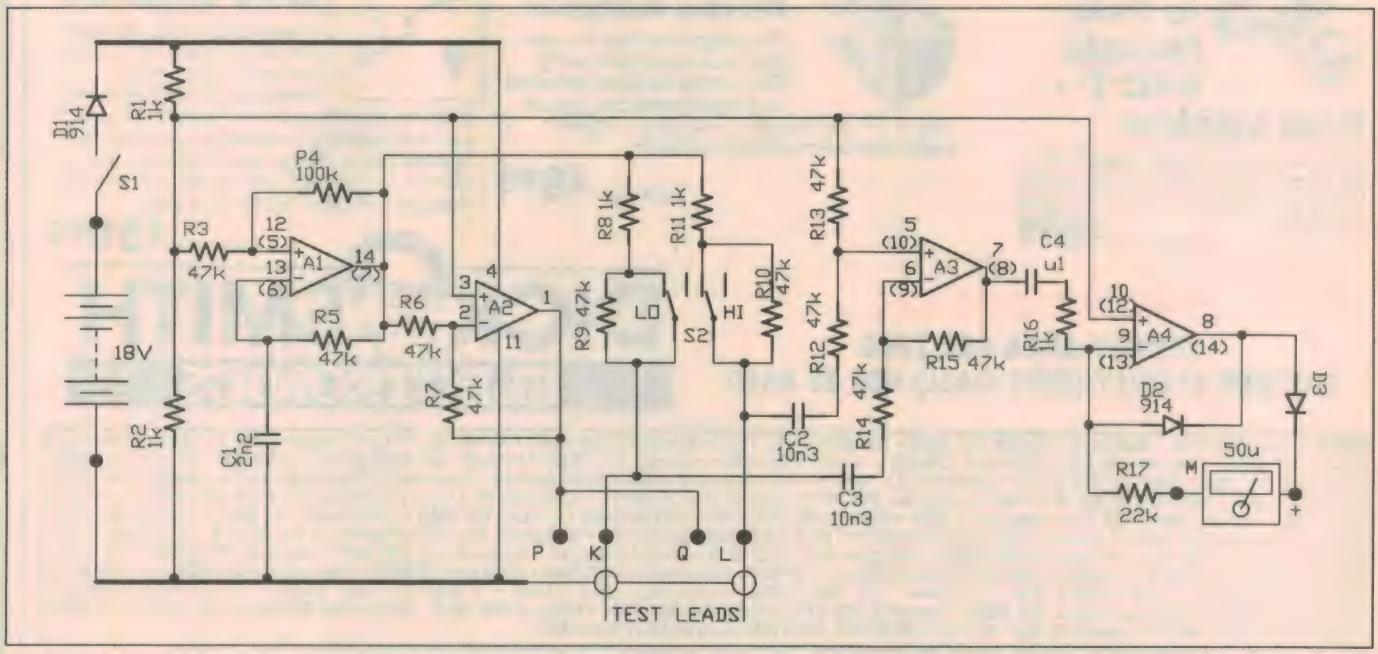
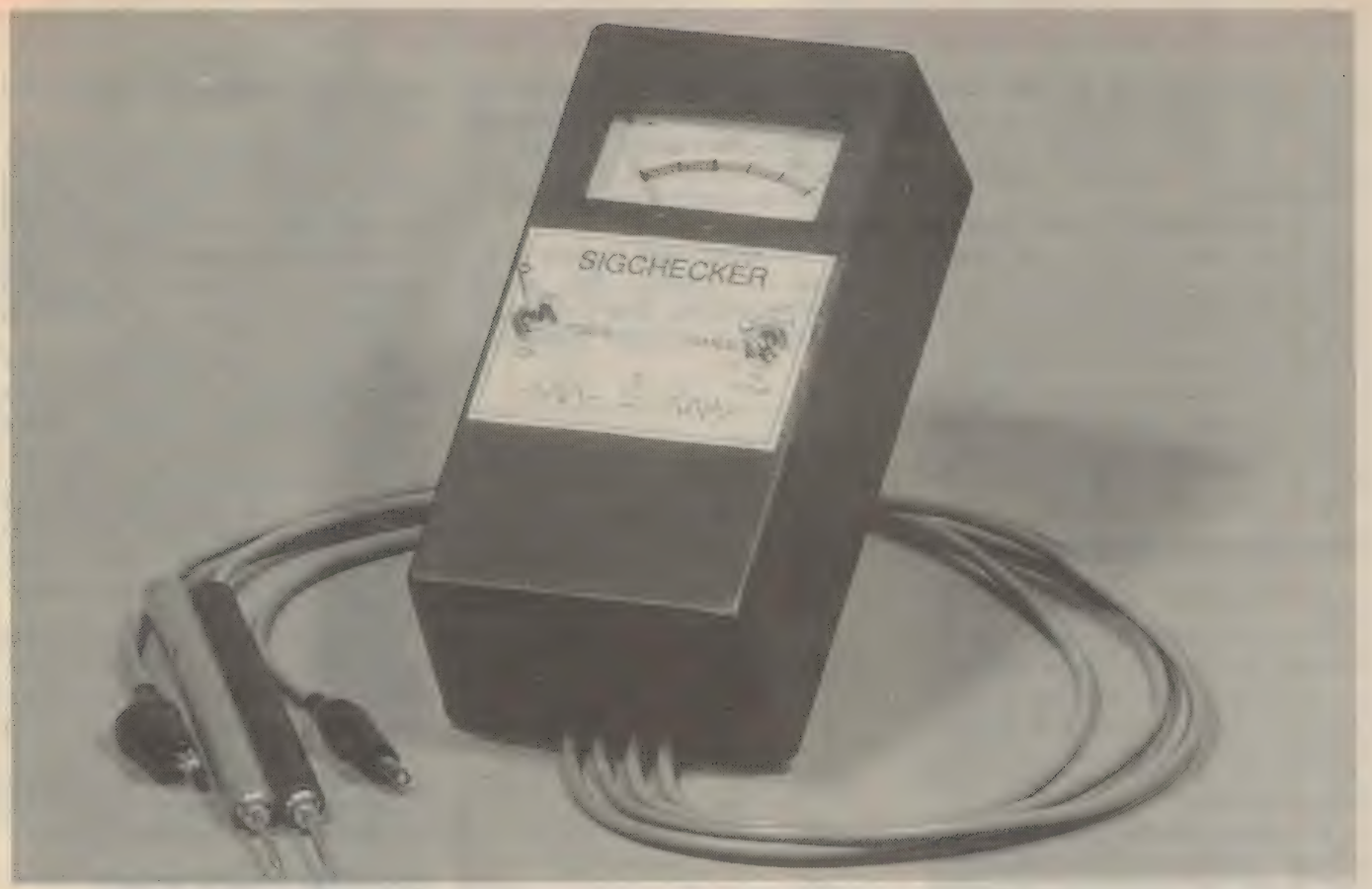


Fig.2: Here's the complete schematic for the author's Sigchecker. It's all based on a single quad op-amp chip, as you can see.



Signature analysers

'Real' signature analysers are complex pieces of analog and digital electronics, often connected to a bed-of-nails setup, sitting at the end of a production line and costing five digit dollars. They do an excellent job in quality control. They can stimulate whole blocks of circuitry with complex waveforms, then analyse the responses and come up with detailed reports identifying present and even future trouble spots and recommending remedial actions.

Then there are the poor man's signature testers. About 10 years ago I came across the first of them, the Huntron Tracker. The instrument had three test wires. One was a 'common', the others had two identical low power sources of AC behind them. The instrument had a CRT which displayed an X/Y plot of voltage against current at one or the other of the AC sources. The display alternated between the two sources.

I bought one of these instruments for my (then) employer and we found it very useful. If you had a faulty board and another good board of the same kind, you could place the two (unpowered) boards side by side, strap the earth lines together, connect the strap to the 'common' lead of the Huntron and press the two AC source probes simultaneously to corresponding points on the two boards under test.

This amounted to signature analysis for one node at a time. If there was a resistor between the source and common, the corresponding CRT picture would be a sloping straight line with a slope proportional to the value of the resistance. A diode would produce a right-angled knee, a zener would produce a 'Z' shaped pattern. A capacitor would produce a circle which was flattened if the capacitor was leaking.

If the two circuits under test were identical, the display pattern would alternate between two very similar shapes. If there was a significant difference, e.g. a good capacitor in side A and an open circuit or a resistor in side B, the display would alternate between an ellipse and a sloping line, two obviously different patterns. We soon learnt that most good pins on transistors and ICs look simply like combinations of zeners and resistors and can be easily distinguished from 'blown' pins which look like open circuits, short circuits or leaky diodes.

Using the tester, one could track down a 'bad' component on a big board in a tiny fraction of the time it would take to find the circuit diagram, interpret it and understand the working of the board. Furthermore, the troubleshooting could be delegated to those not normally inclined to bother about details of current flow in a tangle of components, while those who normally thrive on unravelling such detail could be assigned to writing project specs, work schedules, budgets and grant applications.

Most good and most bad things in life come to an end, and recently I have had to retire from the job which made the Huntron accessible to me. I have had to acquire my own test equipment.

Nowadays many oscilloscopes, particularly those designed for the service technician have a test facility similar to our old Huntron. Unfortunately, I had not the foresight to buy one of those. Instead, I bought an aging top-of-the-line HP model. I have since missed the unashamed simplicity of the curve tracing faultfinder.

I started developing a curve-tracing attachment for the HP, which I thought might make a good hobby project for anyone with a CRO. Then I had the idea of comparing square wave responses. There is no need to display pictures on a CRT to compare waveforms; you can do it with a meter. I now find that I can build a signature comparator from components costing less than $50.

This 'el cheapo' tester is small enough to ride in a service bag beside a multimeter, and can find most components that are more than 5% out of spec. I thought I should share this discovery

Sigchecker: Simplest signature analyser yet!

with other readers of *EA*, and before doing so I decided to give it a proper name to simplify writing about it. Somehow 'SIGCHECKER' seems to be appropriate.

Two versions of the SIGCHECKER are presented here. One is for people prepared to spend an extra $10 or so on a printed circuit board and save themselves the bother of building the circuit on a matrix board; the other is for people who do not mind cutting tracks and messing about with matrix board. The circuit is the same for both versions (except for the pin numbers on the IC and the position of one leg of a capacitor in the circuit).

Square wave testing

As any seasoned CRO driver knows, square waves are handy test signals. They can be generated simply and accurately and they are rich in harmonics — i.e., they contain high and low frequencies together. They can therefore simultaneously test capacitive and inductive circuits, as well as resistances and semiconductors.

The voltage waveform at any point in a circuit depends on two factors: the driving source and the components connected to that point. If the waveforms are not as expected, then the circuit you have is not the circuit you think you have.

Fig.1 shows eight examples of the kind of waveshapes one should expect from the application of a squarewave generator to frequently seen component configurations. Readers who recognise these familiar shapes might want to skip the next paragraph.

In Fig.1 the generator waveforms at point A are the same for all cases. In each case the generator has a source resistance drawn horizontally. The components (loads) under test are drawn vertically. In case I, the (vertically drawn) resistive load simply attenuates the original squarewave, resulting in a reduced squarewave at B.

In case II, the diode clamps point B at about +0.6V above ground during the positive half-cycle. During the negative half-cycle no current flows in the diode and the voltages at A and B are the same. If the load were a zener diode, the voltage at B would be clamped at the zener voltage during the negative half-cycle.

In case III the load is capacitive and the voltage at B cannot rise and fall instantly as the drive at A changes polarity. B rises and falls exponentially along the familiar $1 - e^{-t/RC}$ curve. The bigger the product of R and C, the longer the rise time. If the capacitor were very large, the voltage at B might not finish rising by the end of each half cycle, and the waveform at B would look like a string of bendy triangles. On the other hand, if R or C were small, the rise time at B would be almost as fast as at A.

Case IV shows what happens if the capacitor is leaking. The overall amplitude is reduced. Case V shows the waveform for a capacitor that has a poor connection inside, or has a resistor in series with it. The waveform is almost the same as that in III, except for a very steep initial rise followed by the exponential portion.

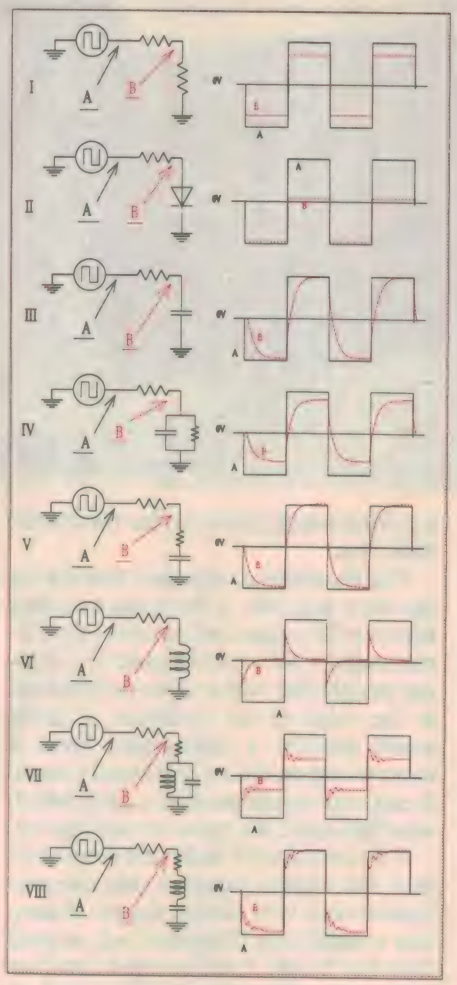


Fig.1: What happens when various common circuit components are fed with a square wave.

The effect of an inductive load is shown in Case VI. The instant sharp spike at B for every change at A is a sure sign that there is an inductor in the load. If there is also a capacitance, as shown in cases VII and VIII, the spikes are blunted, and oscillations occur during the recovery period after the initial slope.

The wiggly waveform in the recovery period is usually called 'ringing' (as in bells) or damped oscillation. The ringing frequency is the resonant frequency of the LC circuit and the decay time of the ring depends on the Q of the circuit. Detailed discussion of ringing waveforms is beyond the scope of this article.

The obvious but often-forgotten general rule in interpreting square wave responses is that in the period immediately after a transition at A, the behaviour of the voltage at B is determined by the reactive components in the load (capacitors and inductors). On the other hand, the level to which B finally settles, i.e. the voltage just before the next transition, is determined by resistive loads.

For small inductors and capacitors the settling period might be very short compared with the cycle time of the square wave. In such a case the test will fail to detect the small components. For large capacitors the settling time may be longer than the cycle time. In such cases the test may fail to detect leakage in a capacitor.

How Sigchecker works

As illustrated in Fig.1, each component configuration has its unique response pattern when stimulated by a square wave generator. This pattern can be called a 'signature'. Signatures of identical components will be identical. Therefore, if the signature of a good component is compared with that of a faulty one, there will be a difference during part or all of each cycle of the source waveform. The SIGCHECKER simply integrates the magnitude of that difference and shows it on a meter.

In practice, there is always a small difference between any two circuits, even if both are OK. Therefore, the meter sensitivity must be set so that only real discrepancies like 10% or more give sizeable deflections.

A further difficulty in choosing the sensitivity arises from the range of impedances that a trouble shooter can encounter. Impedances between 100 ohms and one megohm are commonly encountered, and at least two values of source impedance are needed for the squarewave tester to be useful over such a large range of impedances.

Circuit description

The SIGCHECKER circuit is shown in Fig.2. It is based on a single quad JFET opamp LF347 (A1-A4). A TL074 works just as well. Some LM324 chips seem to

be able to function also, but the 7kHz square wave is too fast for some of them and there are some weird effects.

The circuit will work powered by just one 9V battery and if you live in 'digital LS country' and do not venture into industrial electronics or radio, one of the 216 (or PP3) 9-volters is sufficient. I prefer to have two 9V batteries in series because this enables me to test 'high voltage' components — e.g., 12V and 15V regulators, crow-bar zeners and such like.

BUT BE WARNED: With an 18V supply and on its 'LOW' range, the SIG-CHECKER can drive up to 17mA through the component under test which can damage some components!

In this description the circuit voltages are quoted for an 18V supply. If the supply is different, all other circuit voltages will be correspondingly different. When powered with 18V, the whole circuit uses 18mA with the test leads open and up to 35mA with the test leads shorted.

The batteries are shown at the left of Fig. 2. S1 is the ON/OFF switch, while diode D1 prevents damage if the battery connection is accidentally reversed. R1 and R2 derive a mid-supply bias line of 9V.

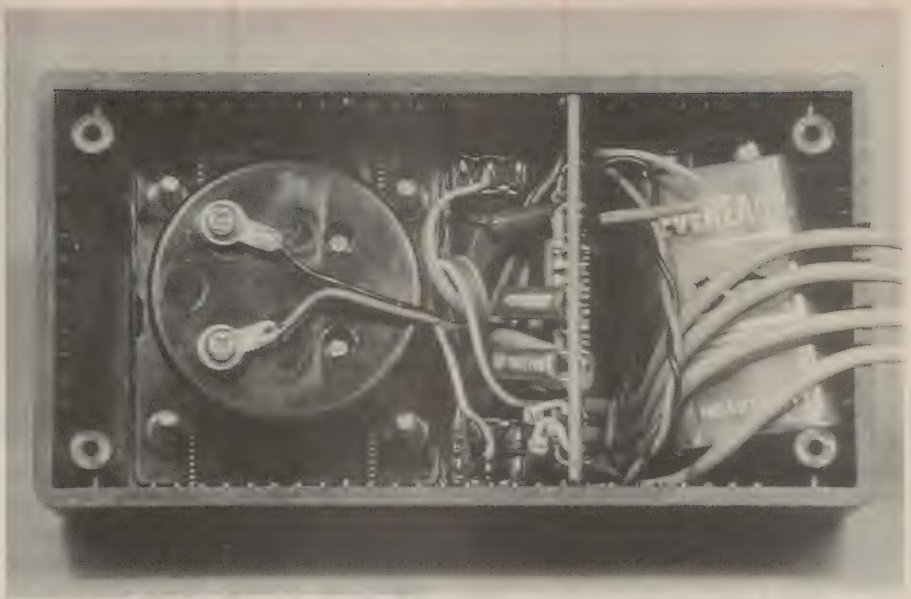
For simplicity of board layout, the matrix board and the PC version do not have the FET input quad amp A connected in the same way. Where the connections are different, the pin numbers in the matrix version are shown in brackets.

A1, the first section of A is the basic square wave oscillator whose frequency is set at about 7kHz by R5 and C1. The voltage across C1 ramps up and down between 6V and 12V as determined by the hysteresis produced by positive feedback resistors R3 and R4.

The square wave from A1 is the test waveform, applied via the source resistors R8 and R11 and through the test leads K and L to the circuits under test. The range switch S2 changes the source resistance of the test waveform. S2 is shown as a DPDT switch because this is the most commonly available.

Only one side is used, making it a DPST type. With the switch in the LO position, the contacts are closed and the source resistance in each lead is 1k. In the HI position, the contacts are open and the 47k resistors R9, R10 are added in series with R8, R9 respectively. The test leads K and L must be screened in order to keep their capacitances to ground constant during testing.

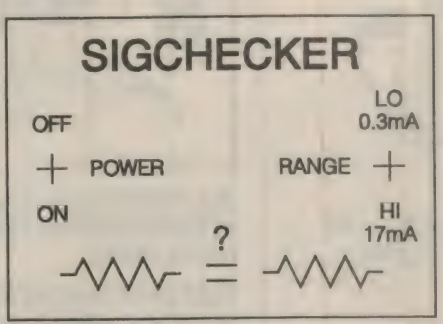
A2 is a unity gain inverter whose output is applied to the circuits under test via the 'common' leads P and Q. With one circuit under test connected between P and K, and the other between Q and L, both circuits are tested with a positive polarity during one half cycle of the square wave and with a negative polarity during the other half cycle. This ensures that diodes are properly checked in both directions.



A shot inside the author's prototype, showing where everything goes. The meter movement is held inside the case by four countersink-head self tapping screws, two from each side.

The signature waveforms appearing at the terminals K and L are compared in the differential input op-amp A3. The need for adjusting input offset is eliminated by AC coupling of the signal with C2 and C3 and restoring the DC operating point to mid-supply with R13. The coupling and DC restoration circuits are such that the output of A3 is at 9V when there is no difference between K and L, and deviates from the 9V level whenever there is a difference.

These deviations are AC coupled via C4 to A4, which forms a 'precision AC to DC converter' with the diodes D2 and D3. The resulting rectified output deflects the 50uA meter. Resistors R16 and R17 set the gain of the converter and thus control the sensitivity of the indication. The meter reading is always positive regardless of the polarity of the deviation at the output of A3.



An actual size reproduction of the front panel artwork.

For a long time I have been trying to design an instrument in which all the resistors are of the same value. The SIG-CHECKER is probably the closest yet: it uses 10 x 47k, 5 x 1k and two others. Has anyone done better?

Unfortunately, there are some less elegant aspects of the design. The two test leads K and L must be screened and the screens must be connected to battery negative. If these leads are not screened, the stray capacitance between the sensing wire and nearby objects (e.g. one's hands) can vary and give quite false indication on the meter. The two leads should be roughly of the same length and made from the same type of cable. The lower the cable capacitance, the better the checker will be at finding small capacitors that have gone open. The two 'common' leads P and Q need not be screened.

A further requirement is that the gains of the two channels in the checker be identical. The eight resistors R8 through R15 must be either within 1% of the nominal value, or they must be in matched pairs, each pair being matched within 1%. If the pairs are not closely matched, the checker might indicate a discrepancy between test objects when there is none, or vice-versa. The pairs to be matched are: R8 with R11, R9 with R10, R12 with R14, R13 with R15. If you use 1% metal film resistors, they will cost an extra 9 cents each and you can forget all about matching them.

I have found that two ranges of source impedance for the excitation signal are adequate. I live on the humid Central

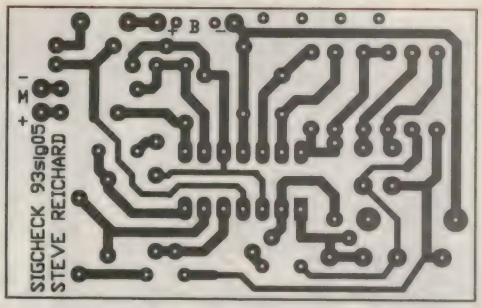


Fig.5: Here's the PCB pattern, reproduced here actual size for those who wish to etch their own board.

Queensland coast where even 'insulators' might not exceed 10M, so any sensible resistor stays below two megohms.

Resistors lower than 100 ohms normally do not break down, and if they do, the burnt remains are quite obvious to the naked eye.

So the SIGCHECKER is intended for comparing circuits in the range between 100 ohms and one megohm. If you need a bigger range, you will have to fit another pair of source resistors to the circuit and a three-way range switch.

The source resistors are 47k (R9 and R10) for the high impedance range, and 1k (R8 and R11) for the low one. Most 'electronic' circuits can be tested on the high range with both poles of the range switch S1 open. Automotive, power and light circuits need the low range.

Construction

The SIGCHECKER circuit can be built on a piece of matrix board as shown in Fig.3 or on a PC board as shown in Fig.4. For those who wish to make their own board, the copper artwork is reproduced full size in Fig.5. The boards are the same size and fit in the slots of a DSE Zippy Box size UB3.

The equivalent Jiffy box H0203 can also be used, but its board mounting slots are not in the right place for this kind of assembly, so the board will have to be superglued in place. In my arrangement shown in Fig.6, the test leads hold the battery in place (saves padding the box with crumpled newspaper), and the batteries make a restrainer for the test leads.

The moving coil meter used in the SIGCHECKER is calibrated 0-50uA. This is meaningless when comparing unknown components. The purists among us should take the cover off the meter and white-out the words 'MICROAMPS DC' on the face.

Painting the scale green from zero to '20' and red above '20' may help later when you are explaining to lay friends what the SIGCHECKER is for. If you believe in making life simple, don't bother to face-lift the meter, just ignore the microamps and confuse the ignorant peasants!

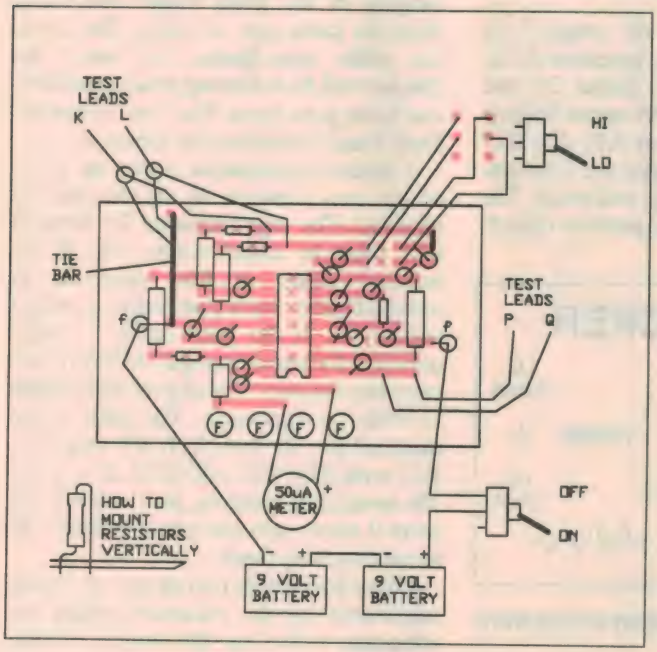
The meter and switches are the hardest to mount, so do that first. I like to mount the meter inside the box so that its plastic cover is protected and does not get broken on the first trip in the toolbox. There is not much room in the Zippy box, so some careful cutting and drilling is needed.

Zippy boxes have sloping sides and rounded corners, so measuring from the edges is quite unreliable. You must draw on the bottom of the box a pair of centre lines, and measure all the centres for drilling and cutting from these lines. In the middle of the bottom of the box there is usually a 'pimple' from the injection moulding machine. This is a convenient reference point for the centre lines.

When the cutting and drilling is finished, the bottom of the box can be sanded smooth to remove the scars of surgery and the pimple. Use fine sandpaper on a flat surface. A few straight, even strokes will remove all signs of centre lines, burrs, bruises etc. If you are not fond of cutting neat rectangular holes, and own a hole saw, cut a 45mm diameter hole instead of the rectangular one.

If your assembly turns out to be bigger than the box (my first one did), mount the meter conventionally with its face outside the box and the meter body in the round hole. This will give you room in the box to mount the board, switches and batteries quite easily, but later the meter will get broken on the way to a job. When the meter and switches are in place, assemble the circuit boards. Six holes must be drilled very close to the lower edge of the board. These are feed-through holes for the test and battery leads.

In Figs.4 and 5 the small holes for the



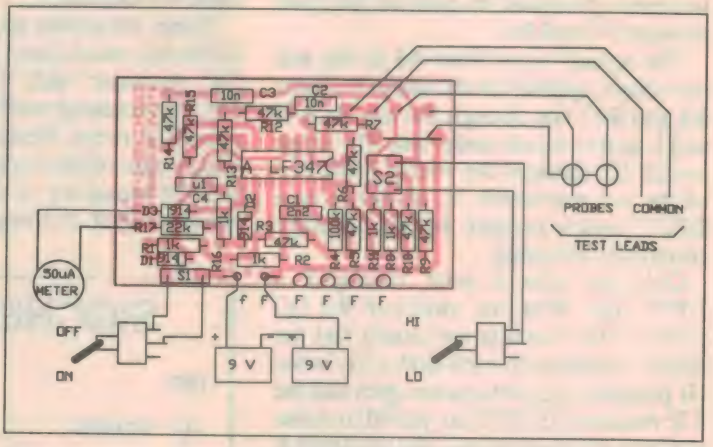


Fig.4 (above): An overlay/wiring diagram for the PCB version of the Sigchecker, showing where everything goes both on and off the board.

Fig.3 (left): And for those who wish to build the unit up using stripboard, here is a diagram showing how to cut the copper tracks, where the place the components and the connections to those that are off the board.

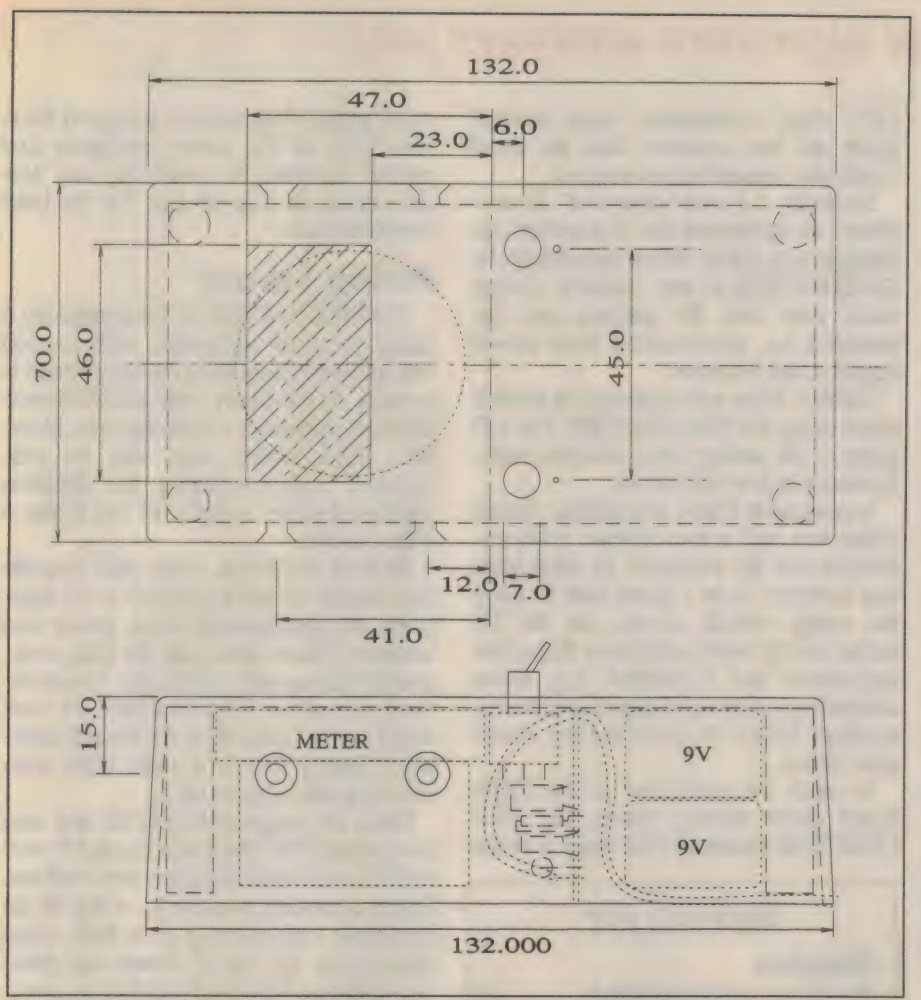


Fig.6: If you're planning to copy the author's physical arrangement, here are diagrams showing the location and size of the various holes to drill in a standard medium-sized jiffy box.

battery leads are marked 'f'. The bigger 3mm diameter holes for the test leads are marked 'F'. The printed circuit artwork has the centres of these holes marked with pads. There is very little room for error when drilling the feed-through holes and you might accidentally break through the edge of the board or graze the bottom track.

This will only affect the appearance of the board. Before placing any components on the board, shape the board to fit snugly into the slots of the box. Note that a slight taper is needed...

Assembling the components on the printed circuit needs no explanation. Board makers often coat the copper side with a varnish to keep it bright. To make soldering easier, wash the board with methylated spirit or any other mild solvent before you start placing the components.

If you are building the matrix board version, the piece of board required is 16 tracks high and 25 holes wide.

The resistors and diodes are mounted vertically to save board space. It is good practice to make two right-angle bends in the tails of components, as shown in Fig.3. For the circuit to work, the copper tracks MUST be cut where marked with 'X' in Fig.3.

It is advisable to make cuts at all the ends of tracks so that no surplus copper stays connected to the circuit.

Things to check when making the board are: Does the board fit the (tapered) box? Is the small link between the two tracks in the top right corner of Fig.3 in place? Are the three diodes pointed the right way? Are the tracks cut in all the 'X' places?

In both versions of the board a tie bar for the screens of the test leads K and L must be made. It is a piece of wire (e.g., a cut off resistor tail) which is connected to the negative rail, and makes a convenient landing strip for the two bunches of very thin screen wire.

The test leads should be long enough to reach the job but no longer. The longer the leads, the greater their capacitance and the poorer the SIGCHECKER's ability to detect faults in small capacitors. Also, the longer the leads the more tangled they get. I like 600 or 700mm of test lead.

After soldering the leads to the board, bend them down and thread them through the feed-through holes at the edge of the board (see Fig.6). Ideally, these holes should be 3mm in diameter, but may simply be half-round notches cut in the edge.

The leads then pass over the batteries, softly holding them in place against the bottom of the box. The leads finally leave the box through four notches cut in the edge of the box and in the box lid. The notches in the box should be a tight fit on the four leads. The circuit boards are quite conventional except for the tie bars and the feed-through holes. There is little room in the box for components that are larger than necessary or are mounted untidily.

The two 'common' leads P and Q should have small alligator clips fitted to their business end. The two screened leads K and L should be fitted out as test probes. The probes may be fine- tipped alligator clips, test prods or hook clips.

The screens are not part of the measuring circuit and should be trimmed off and left unconnected at the probe ends. The probes must be such that there is no contact between the cable inner and the operator's hand. The cable outer must be fixed securely to the insulating probe body. The prototype shown in the photo has a pair of multimeter probes which I find satisfactory.

To restrain the cable, I drill two 3mm holes through the sides of each plastic holder, one near each end of the holder. When the cable is threaded through the holder, it is visible through the holes. After soldering the cable core to the metal tip, then screwing and 'Loctiting' the tip into the holder, I force adhesive through the two holes and into the holder.

Superglue, Liquid Nails or Tarzan's Grip are all equally effective. I have not yet destroyed a probe made in this way. I find that filing the probes to sharp points helps to make good contact when testing lacquered circuit boards.

Firing it up

When all wires and components are in place and soldered up, you are ready to apply power. If you have a regulated power supply (e.g., the one in *EA*, August 1991) you should set its current limit to about 50mA, its voltage to 18, connect the SIGCHECKER and switch on. If you do not have a power supply, connect the battery (9 or 18 volts), switch on and keep fingers crossed.

Sigchecker: Simplest signature analyser yet!

You are unlikely to see smoke leaking out of the wires, but you may still be in trouble. Hopefully the meter will show a small deflection (between 0 and 10uA). If it does, try connecting a 10k resistor to one pair of test leads (P and K). The meter should move rapidly to full scale.

Then connect another 10k resistor to the other pair of test leads(Q and L). The meter should return to a small reading. Now shunt one of the resistors with a 100k resistor. The meter should again speed to full scale. If all these checks work out OK, you have a good SIGCHECKER and can go troubleshooting Commodore 64's, Playmasters, Epsons and the like.

However, a large proportion of well proven circuits that I and other people build don't work when we first power them up. If this happens, remember the rule about the circuit you think you have and the circuit you do have. Then look again at Fig.2 and read the circuit description.

If you do not understand it, you need help from a Guru. If you understand it, then check volts at strategic points. If the voltage is not as expected, examine the components and connections around the sick point.

The first strategic test is to measure the voltage between pins 4 and 11 of the IC. It should be about the same as at the supply. Then check that pin 3 is at half the supply voltage. If you have a CRO, check for square waves on the test leads. The waveforms on the 'common' leads should be in the opposite phase to those on the screened leads.

If you do not have a CRO you can use a multimeter. On DC volts ranges, the meter should read about half battery volts between battery negative and the 'common' leads and somewhat less between battery negative and the screened leads.

The same multimeter should read zero when connected between any two leads. Then check that pins 7 and 8 of the IC are at the same potential as pin 3.

Hopefully, all this checking of voltages will have located the trouble. If you are still lost, contact me via *EA* and I'll try to help.

The small print

The SIGCHECKER is a good simple faultfinding aid, but it has some limitations. Firstly, it can only check the points in the circuit that are accessible to the probes. It cannot detect faulty locations in a ROM or RAM, or a bad register in a CPU chip. Fortunately, such internal faults are less common than the usual 'stuck pin' somewhere on the bus.

Secondly, it is not 'idiotproof'. If connected to equipment that is powered up, damage may result. When connecting the SIGCHECKER to any patients, always make sure that the patients are unpowered, i.e. disconnected from power supplies, and batteries.

Thirdly, some commonsense is needed when using the SIGCHECKER. The LO range is for testing large electros, transformers and low resistances.

It can pump 17mA through the circuit under test and some delicate semiconductors can be damaged by such high test currents. It is a good idea to keep the range switch always on the HI range, except when you know that a low impedance test is needed, e.g. when comparing microfarad capacitors and/or resistors below 1k (look for the multiplier band).

In much the same way as the CRO-based curve tracing testers, the SIGCHECKER cannot find all types of faults on all types of circuits, but it is good for at least 80% of TV, stereo, computer and printer troubles. Its simplicity and low price make it a good tool for the busy troubleshooter.

PARTS LIST

Resistors

10 47k 1% 0.25W metal film (10mm long)
5 1k 1%, 0.25W metal film (10mm long)
1 100k 0.25W
1 22k 0.25W

Capacitors

1 0.1uF 60V or 100V metallised polyester
2 10nF 60V/100V metallised polyester
1 2nF 60V/100V metallised polyester

Semiconductors

1 LF347 or TL074 quad opamp
3 1N914 or similar silicon diode

Miscellaneous

1 Zippy box 41 x 68 x 130mm or similar
1 50uA panel meter, MU45 or similar
1 PCB, code Sigcheck 93sig05, or 41 x 64mm piece of matrix board (16 tracks by 25 holes)
1 Min. toggle switch, DPST or DPDT*
1 Min. toggle switch, SPST or SPDT*
2 9V batteries with snap leads
Four self-tapping screws, No.4, 12mm long, CSK; two metres of screened audio cable 3mm OD; two metres PVC covered flexible wire 3mm OD; two alligator clips; two test probes, prods or hook-clips.
* 'Neck' height 8mm

Putting it to use

The SIGCHECKER is for comparing a faulty piece of equipment with a good one, point by point until the faulty node is located. At the faulty node the difference between signatures will be greatest. However, other nodes may also be mismatched and sometimes the decision whether a node is faulty or not is not a clear-cut one.

To look for faults, make sure that the two boards (or other circuits) to be compared are disconnected from power and batteries. Place them side by side, component side up and connect the 'common' test leads of the SIGCHECKER to what might be the 'ground' of the boards under test. Usually this is a wide track with some big electrolytics on it.

Place the range switch at HI and turn the checker ON. The meter (scaled from 0 to 50) should read between zero and ten. Select a starting point (e.g., a leg on an important looking chip or a high value resistor) on the 'good' board and press one of the probes to it. Note that the meter reads full scale as soon as contact is made. If it does not, you may have a faulty lead or a faulty 'common' connection somewhere.

Check and rectify. Then press the second probe to the corresponding point on the 'bad' board and note that the meter returns to a low reading. If it does not, you may have found the faulty component already, or there is a bad contact between the SIGCHECKER and the boards. Check and rectify.

A rule-of thumb calibration is that full scale reading means a significant mismatch, which is worth investigating (are all the test leads making contact?). A reading between '20' and full scale means that there is a mismatch, e.g. 5% difference in resistors or a 100pF capacitor missing in a 10k load.

A reading below '20' means either that there is a good match or that the circuit under test is 'out of range' of SIGCHECKER's source resistance. Points that have resistors of 1k and less connected to them should be checked on the LO range. All other points should be checked on the HI range.

That's about it. I trust you'll find your SIGCHECKER as useful as I've found the prototype. ❖

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- Sleep Mode
- Min/max recording with time stamp
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- 40μA movement
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- 3% fs accuracy

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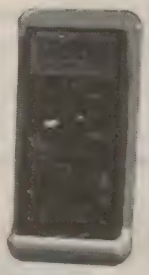

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- Dwell
- Temperature
- Holster

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- 42 seg bargraph
- Min/max hold
- Data hold
- Memory store
- Water resistant
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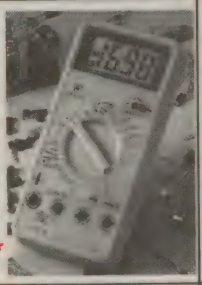

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- Capacitors
- Trimmers
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- SCRs
- LEDs
- Transistors
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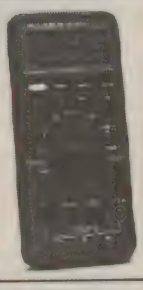

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- 20mA/10A current

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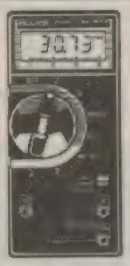

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- 31 segment bargraph
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- Water resisitant
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- 1ms peak min/max recording
- 0.1% accuracy
- True rms
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- Dwell
- Tacho
- Duty cycle
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- Auto power-off
- Water resistant
- 15A current

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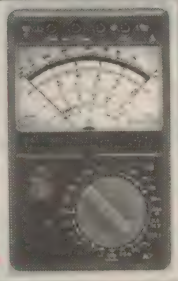
Pantec 50XT



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- 2.5% accuracy
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- dBm,dB V and W
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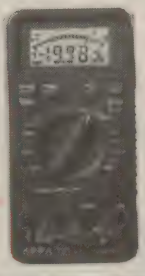

- 3 1/2 digit
- 0.5% accuracy
- Frequency
- Capacitance
- 41 segment bargraph
- Memory offset
- Holster

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Pantec 2045

- 3 1/2 digit
- 0.5% accuracy
- Auto/Manual ranging
- 200μA/10A current
- Temperature with K type tc
- Logic

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- Touch-Hold
- 3200 count digital display
- 31 segment bargraph
- Manual/Auto Ranging
- Holster

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- 36 ranges
- 40μA movement
- Diode test
- 12.5Aac/2.5Adc
- Continuity buzzer
- Carry Case

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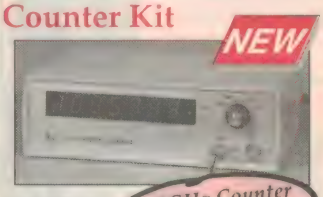

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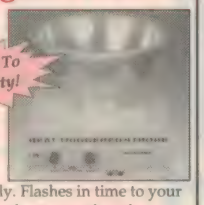

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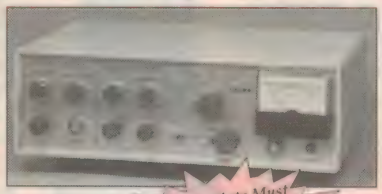
K 5795 Two Tube Option **$16.50**

Low Cost Noise and Distortion Meter Kit

If you design, service, or experiment with audio equipment, this new instrument will fill a gap in your range of test gear. It can measure distortion levels down to less than 0.01% at spot frequencies of 100Hz, 1KHz and 10KHz, as well as providing a built-in low distortion oscillator and AC millivoltmeter. Best of all, it costs a fraction of commercial equivalents!



An Obsolute Must for Serious Hobbyists & Technicians

NEW

K 2542 **$137.95**

50 Mhz Frequency Counter Kit

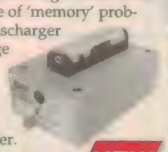
EA Feb '93. This frequency counter kit offers high performance with out a high price tag. Features include an accurate 4 digit LED display, 5 ranges (10kHz, 100kHz, 1MHz, 10MHz, 50MHz) and a BNC input connector.

K 2512 **$89.95**

NEW

Single Cell Ni-Cad Discharger Kit

SC May '93. Do you have problems with nicads that are not performing to their maximum capacity because of 'memory' problems. This low cost discharger will correctly discharge any size single nicad cell so that it can be recharged to full capacity. Supplied with a single AA holder.

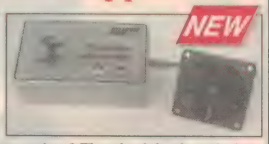


NEW

K 1642 **$27.95**

Woofer Stopper Kit

SC May '93. Do you have a noise pollution of the canine variety? Then bark back with this great kit. Simple push button operation emits a harmless 20kHz signal (beyond human hearing) which irritates the dog and in most cases takes out the temptation for barking.



NEW

Stop that annoying Midnight Bark

K 1165 **$59.95**

Megger Meter Kit

This design of an electronic meg-ohm meter features a dual voltage of 500 and 1000V with a large scale meter. It can resolve resistance from 1M to 200M ohm which is ideal for insulation testing.

K 2555 NORMALLY $79.00
This Month Only $75.00

Amplifier Module Kit Clearance

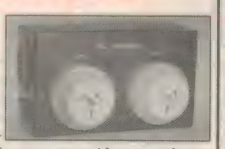
We have a quantity of discontinued amplifier modules which we need to clear to make way for new stock. Both modules come complete with all components (excluding power supply) to build high power amps. Includes heatsink and heatsink bracket. Not available from Altronic Dealers.

K 5140 100W into 4 ohms,
NORMALLY $69.00, **This Month $50.00**

K 5150 150W into 4 ohms
NORMALLY $99.00, **This Month $69.00**

Auto Power Switch Master/Slave Kit

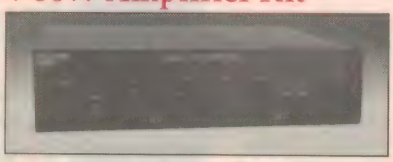
Simply plug in your amplifier the CD, tuner, tape deck etc. and each time you turn on the amp all the others automatically power up. Also great for computers and printers or videos and TV



K 6070 **$59.95**

Compact Stereo 50 + 50W Amplifier Kit

This fantastic new amp has all the features of commercial units costing hundreds of dollars more. Using TIP 142/147 transistors it is capable of producing a total of 47 Watts per channel RMS into 8 ohms. Features 6 inputs, bass, treble and balance controls, headphone jack, tone deafeat switch etc etc. Incorporates polyswitch protection.



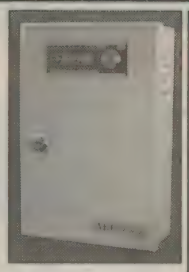
K 5045 **$299.00**

PHONE ORDER - FREECALL 008 999 007

AUSTRALIA WIDE • Jet Express • ALTRONIC COMPONENTS

Protect your Home or Business from Intruders With One of These "State of the Art" Burglar Alarm Security Systems

Economy 3 Sector Alarm Panel



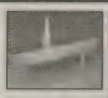
Features:
• 3 Independent Protection Sectors • All Sectors are Compatible with N.O. and N.C. Switches • All Sectors are Sealed with End of Line Resistors • Adjustable Timers for Entry Delay and Siren Duration • Built-in Siren Driver • Output Relay is Selectable for 'Latch' or 'Timing' Operation • Remote Arming and Disarming Control Possible • Remote and Local Alarm Status Indication • Key operated arm and disarm • Requires 16 Volts AC M 9025 Plugpack, and Battery Backup S 5065-7 (Not Supplied)

S 5480 Normally $159.00,

This Month Only $147.50

Ideal for Homes & Small Commercial Premises!

Slider Pots



Hurry limited stock. 50kΩ. Ideal for replacement or new mixers, amps etc.

R 2090 **Only $1.00**

Dual Gang Pots

These dual gang, 100kΩ logarithmic pots include a centre notch making them ideal for balance, tone controls etc. Stocks limited.

Only $1.50

Sorry Not Available from Altronic Dealers

Gell Cell Charger

Charging current 300mA at 12V. Includes red and black colour coded spade terminals for easy connection to most gel cell batteries.

Ideally Suits Lead Acid Batteries Opposite

M 8020 **$12.50**

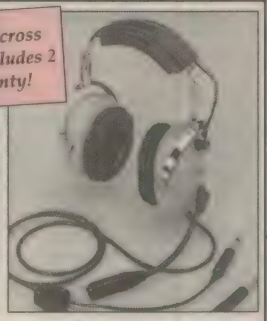
12V Lead Acid Backup Batteries

Premium grade long life. Sealed lead acid batteries. Ideally suited for security alarm panels. Dimensions listed in mm and height does not include connection tabs.

S 5065	1.2AH	$29.95	42W	50H	96L
S 5067	3AH	$44.95	67W	60H	132L
S 5069	4AH	$49.95	68W	100H	90L
S 5070	6.5AH	$54.95	65W	100H	90L

Aviation Headset

1000's Sold Across Australia - Includes 2 Year Warranty!



It was not to long ago when spending $450.00 on an Aviation Headset was not uncommon. Altronics changed all that when we released our C 9070 Aviation Headset for under $189.00. Now with the edition of the flexible boom unit and helicopter version (fitted with a Nato plug) our headsets have gone from strength to strength. Add to this enhanced microphone, improved lead shielding and headband comfort these headsets must be the best value for money in Australia!

C 9070 Standard Model **$189.00**

C 9073 New Flexible Boom Model **$225.00**

C 9072 New Helicopter Model **$249.00**

Aviation Push-to-Talk Switches

Includes quality velcro strap and simple push-button operation.

C 9090 **$29.95**

Alphanumeric Dot Matrix LCD Module

This compact LCD module has 96 inbuilt ASCII characters and 92 special letters which can be displayed on a 16 character by 2 line screen. The module will hold the current input on the display using its own built in memory, thus making it very easy to drive. Some possible applications could be within fax machines, measuring instruments, telephone applications or any other area where machine user feedback is required.

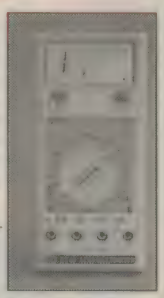
Z 7299 **$35.00**

Z 7309 Backlit Model **$56.95**

This Module can be Programmed for Personalised Messages N.B. Requires Micro-Processor Driver

Digital Multimeter & LCR Meter

This digital meter tests in addition to standard multimeter ranges, capacitance and inductance, enabling you to test a wide variety of components. Indispensable for the design engineer, technician and enthusiast alike.



Q 1062 **$149.00**

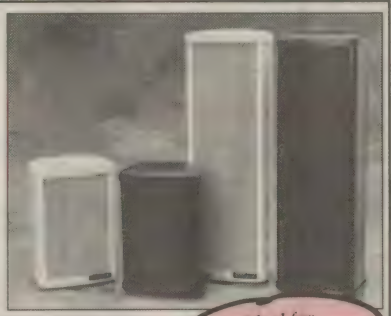
Includes Carry Case

Universal Multimeter Carry Case Q 1052

Excellent padded vinyl case with zipper. Suitable for all meters advertised this month.

Free With Each Multimeter Ordered this Month

Weather Proof Sound Monitors and Sound Columns



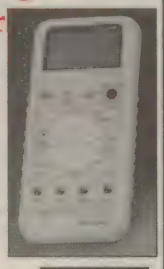
Ideal for Hi-Fi extension, surround sound or outdoor use.

Features: • Rugged extruded aluminium construction • Superb black or white industrial grade powder coat paint finish • Engineer designed in Australia • Excellent reproduction • Superior to imports - yet a fraction of the price • All exterior fixings marine grade stainless steel • Speaker cones treated with special formula to repel moisture

Ideal for Surround Sound!

16 ohm 10 Watt		8 ohm 20 Watt	
C 0938 White	$115.00 each	C 0944 White	$149.00 each
C 0940 Black	$220.00 per pair	C 0943 Black	$280.00 per pair

24 Range Digital Multimeter



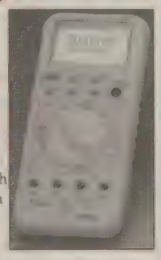
Features 1% Accuracy and Massive 20A Current Check. 3.5 digit. Ranges include AC & DC voltage, AC & DC current, resistance, diode check, transistor check etc. this meter would have to be one of the best value multimeters available today.

Q 1030 **$99.00**

New

Q 1040 Protective Holster to Suit $15.95

24 Range Digital Multimeter



With Frequency Measurement and Capacitance Meter. Includes frequency and capacitance ranges. With the addition of a built in logic probe and screen hold button it would have to one of the most useful DMM's available today.

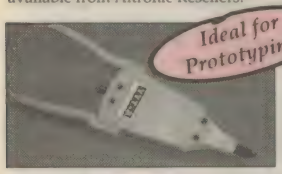
Q 1035 **$169.00**

Q 1040 Protective Holster to Suit $15.95

New

Cut and Clinch Tool

A neat tool which cuts, clinches and burnishes component legs in one stroke. This action holds the component in place for soldering allowing a quicker and easier solder joint. Burnish action improves solder wetting. Lightweight and comfortable. Rugged aluminium body. Durable mechanism. not available from Altronic Resellers.



Ideal for Prototyping!

T 2800 NORMALLY $35.00

This Month Only $17.50

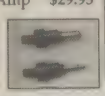
Plug Packs

Our range of adaptors are each fitted with a 1.8M lead, in line socket and M 9014 2.5mm DC connector (different adaptor plugs available as below). Simple polarity setting. All energy authority approved.

Cat. No.	Output Voltage(s)	Max. Current	Price
M 9000	3, 4.5, 6, 7.5, 9, 12 DC	300mA	$19.95
M 9002	12V DC	300mA	$15.95
M 9004	9V DC	300mA	$15.95
M 9005	6, 9, 12V DC	500mA	$22.50
M 9022	12V DC	1A	$24.95
M 9027	16V AC	1.5 Amp	$29.95

Adaptor Plugs to Suit

M 9013 2.1mm DC Plug $1.95
M 9014 2.5mm DC Plug $1.95
M 9015 3.5mm DC Plug $1.95



Auto Ranging 3.75 Digit Digital Multimeter

Triple LCD Display Includes 2 Digital & 1 Bar Graph.
This incredible multimeter would have to be one of the most comprehensive on the market today. It is capable of doing all the normal voltage, current and resistance readings, as well as capacitance, frequency, minimum and maximum sampling, relating measurements, storing previous readings, limit setting, signal transistor gain checking and is full auto-ranging.

Q 1038 **$199.00**

New From ALTRONICS

Q 1040 Protective Holster to Suit $15.95

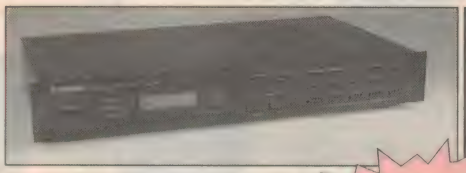
ALTRONIC COMPONENTS

PHONE ORDER - FREECALL 008 999 007

ALTRONIC COMPONENTS • Jet Express • AUSTRALIA WIDE

ALTRONIC COMPONENTS

AM-FM PLL Tuner



This fantastic tuner is the ideal add-on to any sound system. Can be used for background music in restaurants, shops etc. or for any P.A. application. Also a great upgrade for the home Hi-Fi.

Features:

• Digital LED frequency readout display • FET FM front end for high image rejection • Phase-linear ceramic filters are incorporated in both AM and FM IF section • Phase-lock loop (PLL) IC for FM multiplex stage

A 2210 NORMALLY $229.00 **This Month Only $199.00**

This Amp & Tuner Make an Ideal Combination

High Performance Stereo 90W Amp

This stereo amp is ideal for background-foreground music applications. Fantastic for restaurants, shops, discos, PA sound systems and home.

Features:

• 90 watts RMS per channel minimum into 8 Ohms from 20 to 20,000 Hz with less than 0.05% THD • 2 large power meter indicators • XLR sockets for speaker terminals • Output relay to eliminate turn-on and off transients (de-thump)

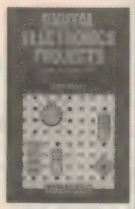
A 2040 NORMALLY $625.00 **This Month Only $550.00**

Practical Digital Electronics

By Mike Tooley. For those people interested in moving into the World of Digital Electronics, this book is an excellent introduction. It offers nine digital test projects to build which can be constructed on veroboard. As well as containing a range of CMOS and TTL data including some pinouts. Suitable for enthusiasts and students alike.

B 2260 **$16.70**

Digital Electronic Projects for Beginners



This is a great introduction to digital electronics with 12 electronic projects to build and experiment with. From huge security to instrumentation and 'fun' projects as well. All battery power full constructional details given.

B 2280 **$15.20**

Spacer Pack Clearance

We have a quantity of 4BA spacers and screws to suit. Not much use separately but together very useful. Each pack contains 100 25mm spacers and 200 10mm screws to suit. Very cheap hardware. Sorry not available from Altronic dealers.

Amazing Value!

Only $10.00 per pack

Electronic Projects for Guitars

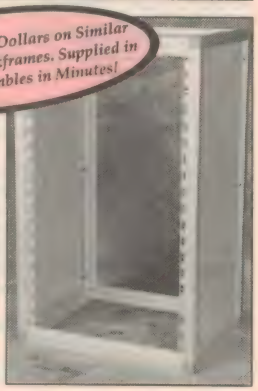
By RA Penfold. Make your own guitar effect pedals from commonly available component. Ideal for both those who are experienced and beginners alike. It's a collection of `16 guitar and general purpose effect units. Each project has an introduction, a circuit diagram and complete instructions.

B 2230 **$21.50**

Suitable for home or commercial use, these fantastic rack frames are durable, strong, good looking, light weight and easy to assemble.

Save Hundreds of Dollars on Similar Custom Made Rackframes. Supplied in Kit Form, Assembles in Minutes!

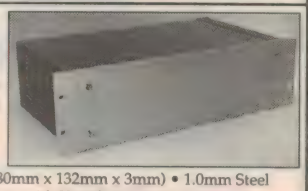
Professional Rack Frames and Panel Sets



The frames are available in either natural (nat) anodised aluminium or Black Powder Coat aluminium and the side panels are either Horizon Blue or Black Powder Coat finish. Ideal for use in home Hi-Fi systems, professional audio installations, Band Gigs, Computer patch panels etc.

H 5204	Rack frame 4U Nat	$139.00
H 5205	Panel set for H 5204	$49.00
H 5206	Rack frame 6U Nat	$149.00
H 5207	Panel set for H 5206	$55.00
H 5212	Rack frame 12U Nat	$169.00
H 5213	Panel set for H 5212	$89.00
H 5218	Rack frame 18U Nat	$189.00
H 5219	Panel set for H 5218	$110.00
H 5230	Rack frame 30U Nat	$229.00
H 5231	Panel set for H 5230	$159.00
H 5238	Rack frame 38U Nat	$269.00
H 5239	Panel set for H 5238	$195.00
H 5304	Rack frame 4U Black	$139.00
H 5305	Panel set for H 5304	$49.00
H 5306	Rack frame 6U Black	$149.00
H 5307	Panel set for H 5306	$55.00
H 5312	Rack frame 12U Black	$169.00
H 5313	Panel set for H 5312	$89.00
H 5318	Rack frame 18U Black	$189.00
H 5319	Panel set for H 5318	$110.00
H 5330	Rack frame 30U Black	$229.00
H 5331	Panel set for H 5330	$159.00
H 5338	Rack frame 38U Black	$269.00
H 5339	Panel set for H 5338	$195.00

High Energy Rack Case

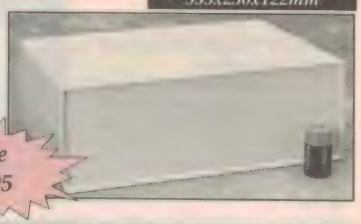


The use of heavy duty heatsinks as rack case sides now allows a myriad of amplifiers, power supplies, battery chargers etc, to be built in an "Off the Shelf" rack case. For very high heat dissipation this design allows the simple fitting of computer type fans to inside back of rear panel, adjacent to each respective heatsink. **Features:** • Uses Altronics H 0590 Heatsinks • Full Size 3 Unit Front Panel (480mm x 132mm x 3mm) • 1.0mm Steel Base, with Ventilation Slots • 1.0mm Steel Top Cover, with Ventilation Slots • Internal Dimensions: 125mm x 370mm x 250mm • External Dimensions: 130mm x 440mm x 252mm

H 0417 Natural Anodised Aluminium Front Panel **Both**
H 0418 Black Anodised Aluminium Front Panel **Normally $129.95, This Month $110**

Super Large Instrument Cases

Massive 355x250x122mm



Designed to house amplifiers, inverters, power supplies micro-processor equipment etc. Built-in mounting posts for PCB's, transformers etc. Ventilated for efficient air-flow cooling. Extra tough, Super finish front and rear panels. Pictured battery for size comparison only.

H 0490 Case **$29.95**

Were $39.95

ALTRONICS

174 Roe St. Perth W.A. 6000
Phone (09) 328 1599, **Fax** (09) 328 4459
MAIL ORDERS C/- P.O. Box 8350
Stirling Street, PERTH W.A. 6849

STANDARD DELIVERY & PACKING CHARGE $3.50 to 500gms, $5.50 500gms -1 kg, $8 1kg-5kg **AUSTRALIA WIDE**-We process your order the day received and despatch via. Australia Post. Allow approx 9 days from day you post order to when you receive goods.

OVERNIGHT JETSERVICE Up to 3kg is $10.00, 3kg to 5kg is $23.00—We try to process your order the day received and despatch via. **Overnight Jetservice Courier** for delivery next day Country areas please allow additional 24-48 hours.

HEAVY HEAVY SERVICE-All orders of 10kgs or more must travel Express Road—Please allow 7 days for delivery. $12.00 to 10kgs. $15.00 over 10kgs.

INSURANCE-As with virtually every other Australian supplier, we send goods at consignee's risk. Should you require comprehensive insurance cover against loss or damage please add $1.00 per $100 of order value (minimum charge $1). When phone ordering please request "Insurance".

TOLL FREE PHONE ORDER-Bankcard, Visa, Mastercard Holders can phone order toll free up to 4pm Eastern Standard Time. Remember with our Overnight Jetservice we deliver next day.

ALTRONICS RESELLERS Chances are there is an Altronic Reseller right near you—check this list or phone us for details of the nearest dealer. Blue Ribbon Dealers are highlighted with a ● These dealers generally carry a comprehensive range of Altronic products and kits or will order any required item for you.

WA - COUNTRY

ALBANY	BP Electronics ●	(098) 412681
	Micro Electronics	(098) 412077
BUNBURY	Micro Electronics	(097) 216222
ESPERANCE	Esperance Comm.	(090) 713344
MANDURAH	Forum Electronics	(09) 5813466
PORT HEDLAND	Ivan Tomek Electronics	(091) 732531
ROCKINGHAM	TV Joe's	(09) 5271806

NT

ALICE SPRINGS	Farmer Electronics	(089) 522388
DARWIN	Ventronics	(089) 853 622

VIC - CITY

	All Electronic Comp	(03) 6623506
	TECS	(03) 6706474
BORONIA	Ray Cross Electronics ●	(03) 7622422
CHELTENHAM	Talking Electronics	(03) 5842386
COLLINGWOOD	Truscott Electronics ●	(03) 4198208
CROYDON	Truscott Electronics ●	(03) 7233860
FOOTSCRAY	G.B. Telespares	(03) 3266035
PRESTON	Preston Electronics ●	(03) 4840191

COUNTRY

BAIRNSDALE	LH & LM Crawford	(051) 525677
BALLARAT	Ballarat Electronics	(053) 311947
BENDIGO	Sumner Electronics	(054) 431977
MILDURA	Pullman Auto	(050) 232882
SHEPPARTON	Andrew Guyatt Elect.	(058) 219497
WARRNAMBOOL	Koroit Electronics	(055) 627 417

QLD - CITY

	Delsound PL	(07) 8396155
WEST END	B.A.S. Audiotronics	(07) 8447566
WOODRIDGE	David Hall Elect.●	(07) 8082777

COUNTRY

GLADSTONE	Gladstone Elect. Services	(079) 724459
	Electronic Enterprises	(079) 726660
MAROOCHYDORE	Mals Electronics ●	(074) 436119
TOWNSVILLE	Super Solex ●	(077) 724466

SA - CITY

	Force Electronics ●	(08) 2125505
BRIGHTON	Force Electronics ●	(08) 3770512
CHRISTIES BEACH	Force Electronics ●	(08) 3823366
FINDON	Force Electronics ●	(08) 3471188
HOLDEN HILL	Force Electronics ●	(08) 2617088
LONSDALE	Force Electronics ●	(08) 3260901
ENFIELD	Aztronics ●	(08) 3496340

COUNTRY

WHYALLA	Eyre Electronics	(086) 454764

TAS

HOBART	George Harvey ●	(002) 342233
LAUNCESTON	George Harvey ●	(003) 316533

NSW - CITY

	A-One Electronics	(02) 2674819
	David Reid Elect. ●	(02) 2671385
SMITHFIELD	Chantronics	(02) 6097218

COUNTRY

COFFS HARBOUR	Coffs Habour Elect.	(066) 525684
NEWCASTLE	Novocastrian Elect.Supplies	(049) 621358
WARNERS BAY	Vilec Distributors	(049) 566792
WINDSOR	M & E Elect. and Comm.	(045) 775935
WOLLONGONG	Newtek Electronics ●	(042) 271620
	Vimcom Electronics	(042) 284400
WOY WOY	Alphatran Electronics	(043) 434919

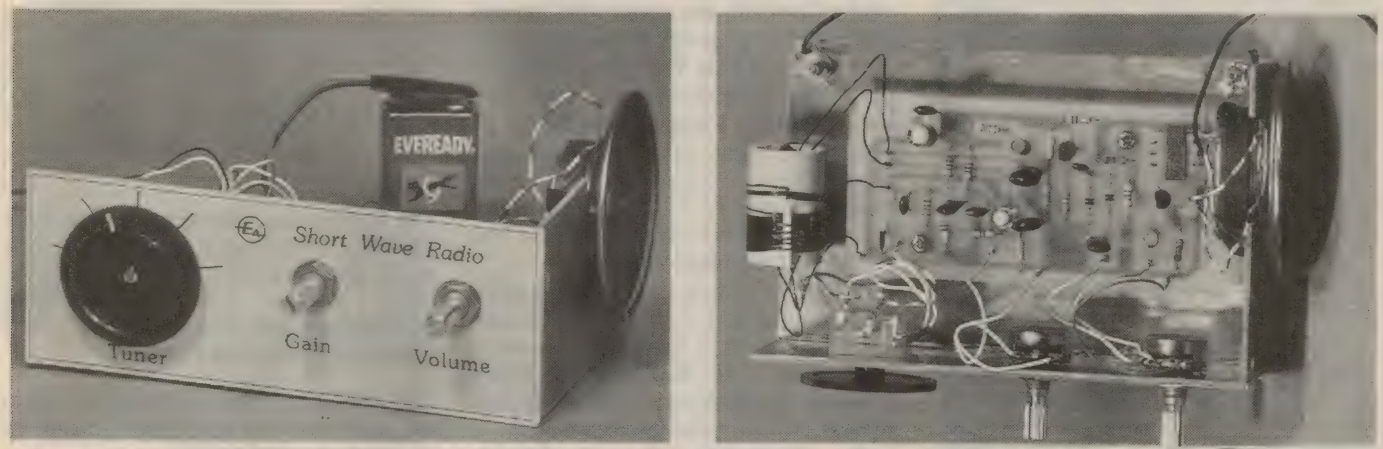
PHONE ORDER - FREECALL 008 999 007

Experimenting with Electronics

by PETER MURTAGH

Beyond mediumwave radio

If you enjoyed building last month's regenerative radio, but would like to listen to higher frequency broadcasts than it could receive, then here is the circuit for a simple shortwave (SW) model.



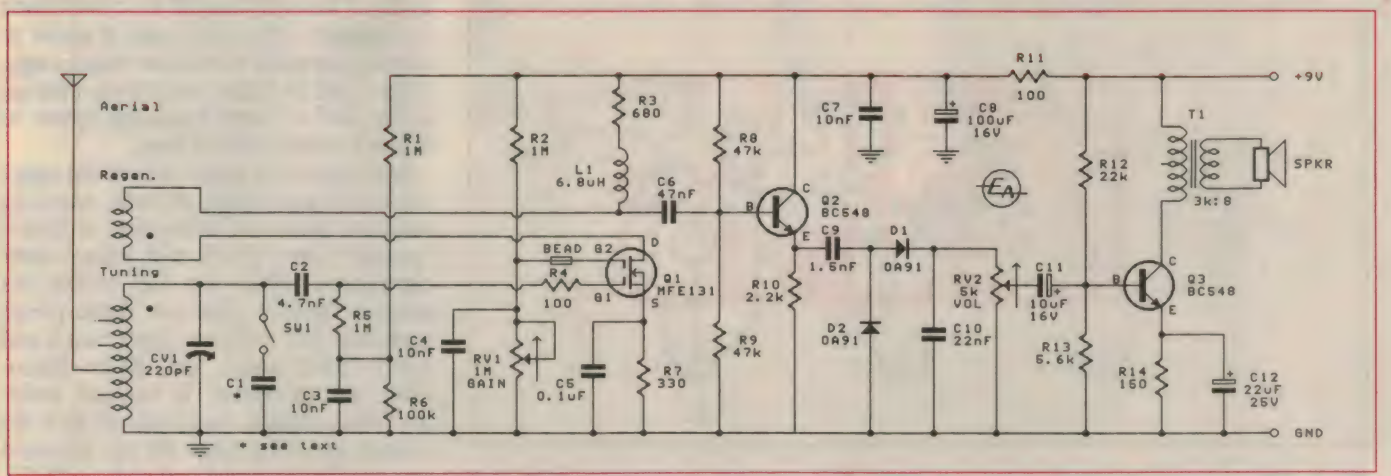
The radio is surrounded by an 'earth plane' made with pieces of PCB material to neutralise stray capacitances. Note on the right hand photo, how the aerial taps are raised over the match-stick on the coil at the left, so that you can connect your aerial to different points on the coil, to improve your signal.

When designing May's reflex/regeneration radio receiver, we had originally hoped that its design could be easily adapted to tune in to shortwave broadcasts, by simply adding a different coil. But we were a bit optimistic! The multiple design proved to be unstable at higher frequencies, and not very selective in its tuning. Hence the need for this month's special SW design.

If you compare the two circuits, you'll see that there isn't really a lot of difference. We have removed the 'reflex' part (positive feedback of the audio signal) of the original design to make it more stable, and replaced the BC548 transistor in the first stage, the RF (radio frequency) amplifier, with a dual-gate MOSFET.

The high input impedance of the MOSFET means that the transistor interferes less with the main tuning 'tank circuit', so the tuning is now more selective. However, we have retained the 'regeneration' feature, to give us its greater sensitivity.

Another feedback problem is also controlled by the use of a dual-gate MOSFET for Q1. At high frequencies, the capacitance of the drain-gate junction of a FET (or the collector-base junction of a bipolar transistor) can offer a feedback



The schematic shows the two sections of the shortwave radio circuit: the RF amplifier built around the dual-gate MOSFET Q1 with its output impedance matching transistor Q2; followed by the detector diodes D1 and D2 and the audio amplifier built around transistor Q3.

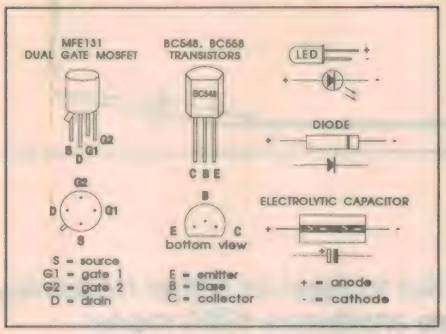


Fig.2 Refer to this diagram to identify the various leads of the polarised components which you will use in this circuit.

pathway. This can result in the circuit oscillating at certain frequencies.

The dual-gate MOSFET acts like two transistors connected in series, with stage 1 being a current amplifier and stage 2 a voltage amplifier. (Just how this reduces impact of the feedback through the junction capacitance will be explained later.)

Another addition to the circuit is transistor Q2. Its purpose is to match the relatively high output impedance of the MOSFET to the lower input impedance of the audio amplifier stage. This means that the output of Q1 can be used more efficiently.

Construction

Start by winding the coils. Again — as we did last month — we have specified 0.5mm diameter wire (25 SWG wire, B&S 24) to make the best use of the signal received, but this time the aerial coil is wound with five taps to make it easier to match the aerial to the tuning circuit.

A shortwave coil is physically much smaller than one for a lower frequency because less turns are needed to achieve its lower inductance. So it is practical to wind the coils with an air core rather than a ferrite rod.

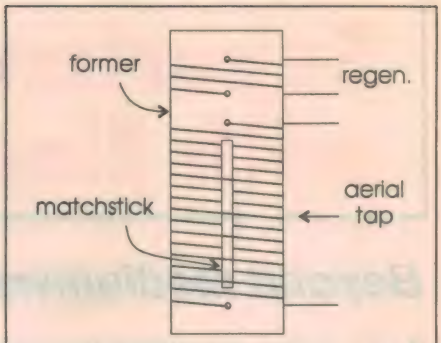
Let's talk about the 5 - 10MHz coil first (see Fig.3 for details to wind two other coils for lower frequencies). Note that the 'Parts List' gives the length of wire needed for this coil only.

To make life easier, we wound this coil on a 30mm length of 20mm diameter plastic electrical conduit. Such conduit is quite common, and being plastic means that you can drill holes to fix the beginning and end of each winding. But if you can't find a piece of conduit, you could wind the coil on a rolled-up piece of cardboard instead.

Drill a small hole 5mm from the end of the conduit to anchor the first wire. You will need about 1.25m of wire for the 16 turns of the main coil — each loop takes about 70mm — which will leave about 70mm for each of the connecting leads. Poke the first lead through the hole you have drilled, then start winding.

Remember that we want to make aerial 'taps' at turns 2, 4, 6, 8 and 11. An easy way to do this is to wind the wire over a match-stick so that these turns are raised above the plastic former to allow easy attachment for the aerial lead (see Fig.3).

You will find that you can't slide the match-stick along after you have wound any wire over the top. So place it in its final position, and slide the turns of wire which are not to be tapped underneath it. Next, use a sharp knife to scrape off the enamel insulation from the five tap wires. Because these taps are close together, we scraped them alternately on both sides of the match-stick. When the first coil is wound, drill a second hole to anchor the end of the wire. Leave a 5mm gap, drill a new hole, then wind the second length of wire (320mm long) for the regeneration coil with its 3 turns. This coil is wound in the same direction as the first. Anchor its end through a fourth hole.



Coil winding data

frequency	No. of turns	
	aerial	regen.
5 - 10MHz	16	3
2.2 - 5MHz	40	9
1.5 - 3MHz	80	16

Fig.3: This diagram shows how to raise the 'tap' wires over the match-stick to make for easier aerial connection. The table shows the coil winding information for three different, but adjacent, frequency bands.

As can be seen on the schematic, both connections to the MOSFET Q1 come from the tops of the two coils. The top of the aerial coil goes to gate 1, and the top of the regeneration coil goes to the drain. This applies the feedback signal with a phase reversal in the regeneration coil (see why in the 'How it works' section). So mark the beginning of each coil in some way, for later identification.

Drill another hole on the side directly opposite the match-stick, and well clear of the regeneration winding, for a small bolt to fasten the coil when all the construction is complete. This will make it easier to connect the aerial wire to the various taps, as they will be facing straight up. (We actually used a 10mm insulating spacer to fasten it, as is explained later.)

Next make the frame to hold the radio. As we did last month, we built ours from pieces of unused PCB material, to form a 'ground plane' which will reduce stray capacitance. (Why not just re-use last month's frame?) Our two frame pieces measured 130 x 50mm (front panel) and 130 x 80mm (base), but these dimensions are not critical. If you are building from scratch, remember to drill the various mounting holes for the insulated spacers (for the aerial coil and the PCB), and for the pots and the tuning capacitor. It is much easier to drill before any components are attached.

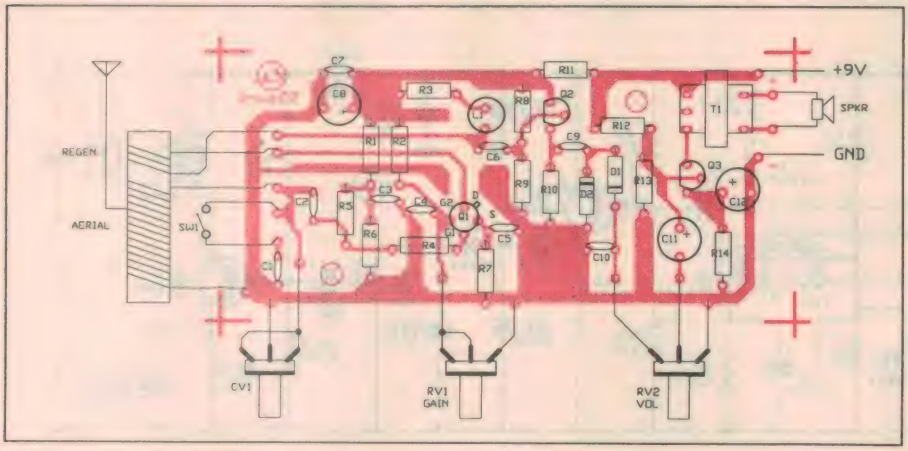


Fig.1: The component layout for the PCB. The variable capacitor (CV1) and resistors (RV1, RV2) are shown with their spindles horizontal and their tags pointing upwards. Note the large earth tracks which act as shielding around the signal tracks.

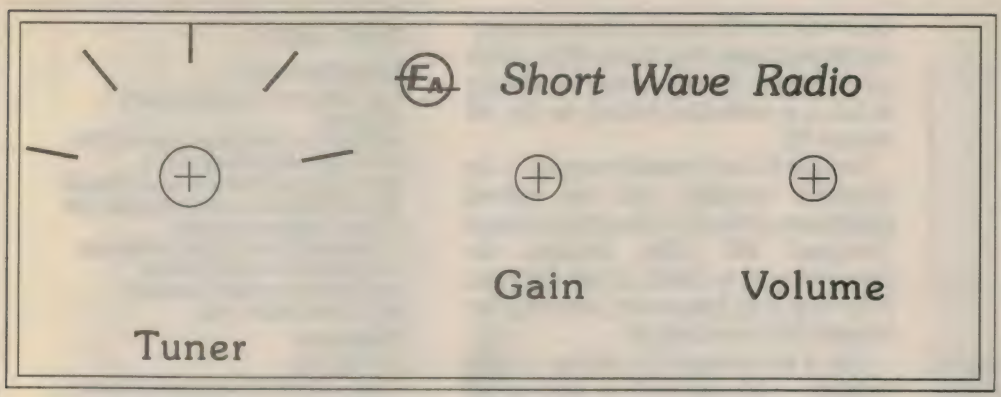


Fig.4: Here is a full size copy of the artwork for the front panel of our radio.

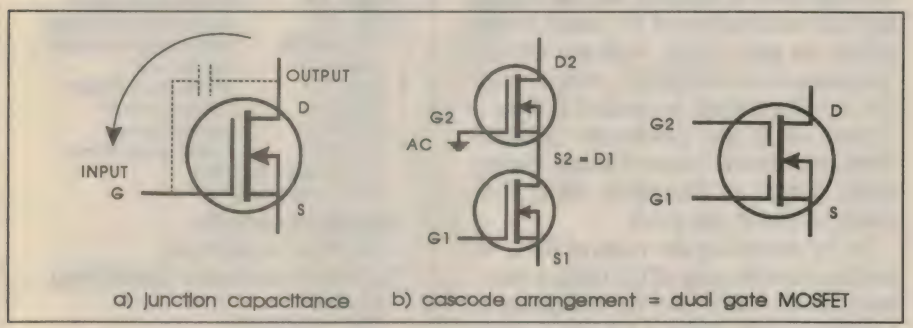
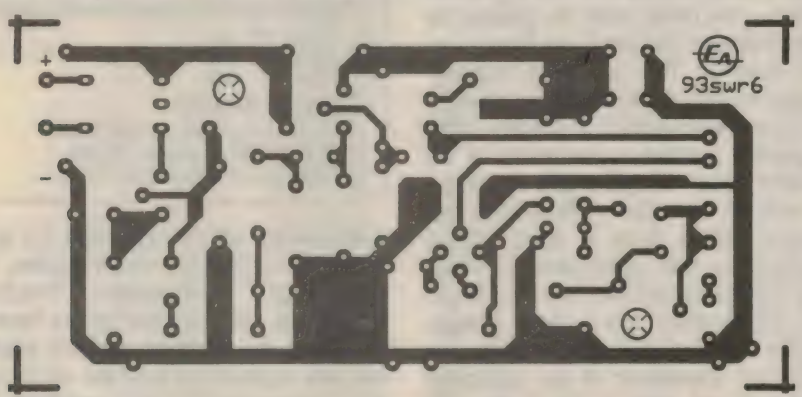


Fig.5: Junction capacitance can offer an unwanted feedback path at radio frequencies. The 'cascode'-type arrangement of the dual-gate MOSFET helps us reduce this problem and so makes the circuit more stable.



If you wish to etch your own board, then make use of this full size PCB pattern.

Now solder the various components to the PCB, making sure of the correct orientation for the polarised components. Refer to Fig.2 to identify the various pins.

When it comes to inserting the 4-pin dual gate MOSFET, use the component overlay diagram in Fig.1, because it clearly shows where the transistor tab goes. This should make it easy to get the orientation of Q1 correct.

Remember to pass the G2 lead through the small ferrite bead and then through the hole in the PCB, before soldering. This will make the transistor sit about 5mm above the PCB. Push Q1 down against the bead so that it doesn't sit any higher than this. Again, we have not given alternative construction plans for stripboard and breadboard, because of the problems of instability which can arise because of the layout.

Next connect the leads to the coils (remember that the top of each connects to transistor Q1), to the tuning capacitor CV1, and to the two potentiometers RV1 and RV2. Note that switch SW1 and capacitor C1 are optional extras. See the later section on 'Changes' to see if you wish to include them.

Now bolt the PCB and the aerial coil to the ground plane base, using the insulated spacers. The PCB needs to be isolated from the ground plane to prevent shorting and the coil to prevent any interaction.

Finally, use Fig.4 to photocopy the artwork that we used for our front panel, and glue it on the front of your radio. In order to obtain reasonable reception, you will need to make a good earth connection (to a water pipe, etc.) and a fairly long aerial. For the aerial, use a length of wire about 6m long and strung up as high as possible.

Tuning

Turn both the gain and the volume up quite high, then rotate the tuning capacitor until you can hear a station. Try adjusting the gain up and down to get the clearest reception. Also connect the aerial to the different taps of the aerial coil. Remember that the further your aerial connection is from the earthed end of the coil, the louder your signal will be — but the less selective your tuning. Find the best compromise.

If required, change the volume control to give a comfortable listening level. You will probably have to make several minor adjustments to all the controls to get the best overall result.

If you wish to check that your coils leads are connected with the correct polarity, temporarily short out the regeneration coil. If this decreases the signal level, then the connections are correct — but if the signal increases, then your regeneration coil connections must be reversed!

Changes

The main change that you can make with this circuit is to extend its tuning frequency above or below its current range. Fig.3 gives the details for winding three different coils to cover quite a large frequency band. If you wish to go for even higher frequencies, then reduce the 16 turns of our first coil. Keep the number of turns for the aerial and regeneration coils in roughly the same proportion (16:3).

Coil 1 requires about 1.5m of wire for its 16+3 turns (70mm/turn), so coils 2 and 3 will need about 3.5 and 6.8m, respectively.

Alternatively, instead of making different coils, you can use switch SW1 to add various value capacitors (one at a time) for capacitor C1, in parallel with the tuning capacitor CV1. Increasing the capacitance is another way to decrease the frequency.

This method is obviously easier than winding and connecting new coils, but it does restricts the width of the band over which you can tune.

Table 1 shows the effect on the tuning band of using several capacitor values for C1, still using our basic 16-turn coil:

Table 1

C1	freq. range
-	5.0-10MHz
220pF	3.6-4.8MHz
470pF	3.0-3.4MHz
560pF	2.7-3.0MHz
820pF	2.4-2.7MHz

How it works

The signals absorbed by the antenna are fed into the tank circuit, which comprises the aerial coil and variable capacitor CV1 (and C1, if connected). Our design this month uses only one coil with 'self-induction' rather than the two separate coils we used in the May design. However, both circuits work in a very similar fashion, with the magnetic field produced by the antenna signal inducing a current in the main coil.

The use of various taps on the coil means that it is easy to adjust the loading of the aerial on the tuning circuit. The smaller the section used as the primary coil, the smaller the loading — but of course, the smaller the signal also! As usual, you should try various positions until you find the best compromise between strength and selectivity.

Consider now the biasing arrangement on the MOSFET (which looks worse than it actually is!) Resistors R1 and R6 provide a bias voltage for gate 1 of about 0.8V.

The join of these two resistors is connected to ground for RF (radio frequency) via capacitor C3. This gives us a stable DC bias for our transistor, which won't fluctuate with the RF signals. To avoid lowering the high input impedance of Q1, which would happen if the bias was fed directly to G1, it is connected instead via the 1M resistor R5.

Resistor R4 is a 'parasitic stopper' — its resistance combines with the internal capacitance of the G1-S junction to form a 'low-pass' RC filter. Because the capacitance is so small, it will filter out only very high frequencies, allowing our intended RF ones through.

Gate 2 of transistor Q1 also has its bias resistors — R2 and RV1 — with an RF bypass via capacitor C4 for DC stability. Because RV1 is variable, we can change the bias from zero to +4.5V, which in turn affects the gain of Q1. Note that Q1 is a 'depletion mode MOSFET', which means that it will continue to conduct if there is no bias on its gate (unlike the 'enhancement mode' model we used in our 'Battery saver' circuit in December 1992. This needed a bias to turn it on).

So, by increasing the value of RV1, we can increase the gain of Q1 (with a maximum about 4.3V), and by decreasing it, we can actually make it act like a signal attenuator. This reduction in signal strength occurs when the bias is about 1V.

This biasing circuit also has a parasitic stopper — the ferrite bead. By passing the G2 lead through this bead, we form a low value inductor. This acts as a high impedance for very high frequency signals.

A big problem with RF amplifiers is that the internal junction capacitances of the transistor (even though small) can interfere with its operation at these high frequencies. When there is large voltage amplification, this capacitance is effectively multiplied, and becomes even larger when the amplifier has a phase change. And the higher the signal frequency, the smaller the impedance of the capacitive junction. If you look at Fig.5, the first diagram shows how the drain-gate junction capacitance forms a feedback link, which can both reduce the transistor gain and cause unwanted oscillations at particular frequencies.

Enter the dual gate MOSFET to the rescue. It is like two transistors connected in series, with the drain of the first joined to the source of the second (see Fig.5b). This type of setup was first used with valve amplifiers, and is called a 'cascode'. Its advantage is that stage 1 is set up in the common-source configuration and so acts as a current amplifier — remember that it is the voltage amplification which multiplies the junction capacitance. Hence stage 1 does not cause a major feedback problem.

Stage 2 becomes the voltage amplifier. But the gate of the top MOSFET is grounded for AC (via capacitor C4 in the schematic diagram), which makes it a common-gate configuration. Therefore, the voltage amplification occurs between the source and the drain, and this junction has less capacitance than the source-gate one — hence less feedback problems. The AC-grounded gate acts as a shield.

The net result is that we have our voltage amplification, but not across a junction that causes sufficient feedback for spurious oscillations. Another advantage of this arrangement is that it allows the gain to be adjusted by varying the DC voltage at gate 2. Because it is so easy to adjust the gain, we have not added separate adjustable regeneration to the circuit. Instead the full output of Q1 is fed via the regeneration coil, and the amount of regeneration is then reduced by lowering the amplifier gain. The regeneration coil is designed to provide positive feedback, to increase the signal that we are tuned to. This makes the tuning more selective.

Continued on page 85

PARTS LIST

Miscellaneous

PCB 102 x 48mm, coded 93swr6
9V battery
60/160pF variable gang capacitor CV1
8-ohm speaker or headphones
30mm length of 20mm-diameter conduit
1.6m of SWG 25 enamelled copper wire
3 10mm insulated spacers
1 5mm long F29 HF/UHF ferrite bead
1 6.8uH radio frequency choke
'ground plane' material (see text)
hookup wire, solder, etc.

Resistors

All 1/4W, 5%

3	1M	R1,R2,R5	brown-black-green
1	680	R3	blue-grey-brown
1	100	R4	brown-black-brown
1	100k	R6	brown-black-yellow
1	330	R7	orange-orange-brown
2	47k	R8,R9	Yellow-purple-orange
1	2.2k	R10	red-red-red
1	100	R11	brown-black-brown
1	22k	R12	red-red-orange
1	5.6k	R13	green-blue-red
1	150	R14	brown-green-brown
1	1M lin. rotary pot		RV1
1	5k lin. rotary pot		RV2

Capacitors ceramic

1 220-820pF C1 (optional)

Capacitors polyester (greencap)

1 4.7nF C2
3 10nF C3,C4,C7
1 0.1uF C5
1 47nF C6
1 1.5nF C9
1 22nF C10

Capacitors PC-mount electrolytics

1 100uF,16V C8
1 10uF,16V C11
1 22uF,25V C12

Semiconductors

1 MFE131 dual gate MOSFET Q1
2 BC548 NPN transistors Q2,Q3
2 OA91 germanium diodes D1,D2

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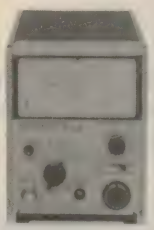

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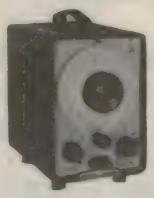

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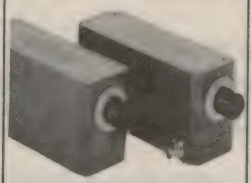

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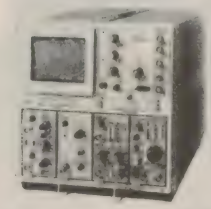

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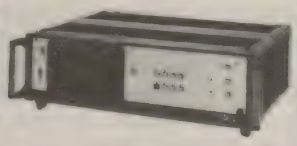

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HP 778D Dual Coupler .01-2GHz	$1500	HP 419A DC Null Voltmeter	$275	0,1,2,4,6,7	3pcs/$4.50
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HP 3400A True RMS Voltmeter	$275	HP 86 Calculator/Controller	$80	WHITWORTH THREAD TAPS	
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HP 400D AC Millivoltmeter to 300V	$65	HP 214A Variable Pulse Gen	$225	1/8" Whitworth Sets	3pcs/$3
HP 211A Square Wave Generator	$75	HP 7100B 2 Pen Chart Recorder(as is)	$80	9/16" Whitworth Sets	3pcs/$3
HP 3320B Freq. Synth 13MHz	$550	HP 1707 Dual Trace CRO 75MHz	$800	3/4" Whotworth Plug HSS	$2
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SHORTWAVE LISTENING

by Arthur Cushen, MBE

Germany's external service celebrates 40 years

Broadcasts from Germany were heard in the 1930's, operating from Berlin; and of course during the war years. The Federal Republic of Germany commenced its shortwave service in 1952, and now it is one of the largest external broadcasters in the world, operating more than 90 hours a week in 35 languages.

The celebration of 40 years of broadcasting has been dampened for Deutsche Welle, by major budget cuts. This has occurred at a time when Germany has also become responsible for the radio activities of the former East Germany and Radio Berlin International.

When Deutsche Welle takes over the European service of Deutschlandfunk, the languages broadcast will be increased to 40! According to the Head of the Transcription Service of Deutsche Welle, in a broadcast on Media Network, 40 languages are too many — so talks are going on to reduce the number to around 25.

It will all depend on how many languages Deutsche Welle can afford. These should include the major languages — English, German, Chinese, Spanish, Portugese, French, Hausa, Urdu, Hindi and Russian, and others with a strong listening audience. However it will be five years before the full plan is implemented.

There was also discussion about moving Deutsche Welle from its present radio building in Cologne to the Federal capital in Bonn. But this has not been agreed to, as Bonn has no suitable building to be converted into a radio headquarters.

On May 3rd, 1953 the first broadcasts of Germany's international radio service started with a three hour programme in German from a Cologne studio. It was a modest beginning. There was only one 20kW transmitter to beam the programme around the world, to a mainly German audience. When Deutsche Welle started its operations 40 years ago, few people would have foreseen its enormous expansion. At that time, Germany was still suffering from the effects of Nazi rule and the Second World War. The country was in ruins and divided by the Iron Curtain. Worse still, Germany's image abroad was tarnished by the horrors and crimes committed by Germans during the Nazi period. However, from the start, DW and other international radio stations were committed to the principle of free flow of information across national borders.

This world map shows the location of Deutsche Welle transmitters in Germany and relay bases in other parts of the world.

Relay bases

The first relay station put into operation by Deutsche Welle was in Kigali, Rwanda in Africa and is celebrating an anniversary this year, as it was exactly 30 years ago that the station went into operation. At first it only had a test transmitter, but after completion, had at its disposal two shortwave transmitters with a capacity of 250kW each.

After three decades of continuous operation, a modernisation and an extension of the plant had become necessary. This work was recently completed, enabling the Kigali relay station to operate with four modern shortwave transmitters. Ten new transmitting antennas have been erected, and the existing ones have been brought up to modern standards.

This item was contributed by Arthur Cushen, 212 Earn St. Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Daylight Time and 12 hours behind NZ Daylight Time.

As well as the relay base at Kigali, there are also DW transmitters at Sines (Portugal), Malta, Antigua and Sri Lanka. Additional transmitters are being used via Radio Canada International, Radio Brazil and in the CIS. Send all correspondence to the broadcaster's new address: Deutsche Welle, 50588, Cologne, Germany.

Shortwave for Hawaii

The announcement that WHRI of Noblesville, Indiana is constructing a shortwave transmitter in Hawaii means yet another name will be added to the list of countries of interest to shortwave listeners.

The writer actually verified Hawaii during World War II, when the Voice of America had several transmitters near Honolulu using the callsign KRHO and various other similar calls — but these transmitters were dismantled after the War.

The new transmitting site will be eight miles from the southern-most tip of the United States, on the big island of Hawaii. The transmitter is expected to be installed in July/August and tests are expected sometime in September or October. The programmes will originate in South Bend,

Indiana and will be sent by satellite to the transmitter in Hawaii.

The new site will enable WHRI to broadcast to the South Pacific, into South East Asia, and in particular into China. The present service from Noblesville covers Europe, the Caribbean and North America.

WHRI's main frequency is 7315kHz, which is observed around 0600UTC. On Tuesday and Friday 'World of Radio' with Glenn Hauser is broadcast. Other programmes put together by United States residents are carried in the languages of several countries in Europe.

Broadcasting to Cuba

There are many United States medium and shortwave stations located in the US southern states, and in Central America, which broadcast to Cuba in anti-Castro type programming. The leader, undoubtedly, is Radio Marti which is funded by the Voice of America and operates on medium wave 1180 and shortwave 6030kHz, and is heard regularly around 0800. Many programmes are put together by exiled Cubans broadcasting to their homeland, and these are carried on a variety of private shortwave stations, including WRMI, Radio Miami International.

In the past its programme services have been carried on other stations, but now WRMI is building its own studio and transmitting site in a suburb of Miami. Jeff White, the manager of WRMI, recently purchased a 50kW transmitter from the former Radio Clarin in the Dominican Republic, which used to operate on 9950 and 11,700kHz.

The transmitter has been stored in a warehouse, but now plans are rapidly under way to get this broadcaster into operation, beaming into Cuba and Latin America in general. ❖

AROUND THE WORLD

ANTARCTICA: The American Forces Network operated a shortwave station on 6012kHz many years ago, and reports that it has been reactivated have been denied. The transmitter is permanently off the air in order to reduce the impact of high frequency transmissions at various Antarctic stations. The Antarctic bases of McMurdo Sound and Scott Base are provided with FM transmissions from McMurdo, where there is also Cable TV fed to most of the buildings.

COSTA RICA: Radio for Peace International, Santa Ana has been heard with a strong signal on USB 7375kHz at 0700 on Monday, with Glenn Hauser's 'World of Radio'. At 0730 the station announces its address, and asks for reception reports to be accompanied with three IRCs. A signal on AM on 7385kHz is also being received, though its not as strong as the SSB outlet on 7375kHz.

GERMANY: A new test transmission has been heard from Radio Ropa Info. (PO Box 5568, Daun, Germany). Reception has been excellent in the South Pacific from 0300 on 5980kHz, with lengthy German announcements indicating frequency and postal address, and popular English recordings with announcements after each item. The transmitter is being hired, and is located in the Czech Republic. Its full schedule is 0300 - 2300 each day.

PALAU: Station KHBN High Adventure Ministries from Palau in the Central Pacific is to add a second 100kW transmitter shortly. It has also extended its language services with the introduction of Persian; while English is now broadcast from 1200 - 1400, 1500 - 1530 and 2030 - 0100 on 9830kHz.

RUSSIA: AWR The Voice of Hope has been heard with a strong signal on 15,125kHz with English 0430, German 0500 and Polish 0530. The station requests reception reports to be sent to AWR, PO Box 388, 1-47100, Forli, Italy.

Radio Galaxy, PO Box 7, Moscow confirms reception with a letter indicating that it operates on 11,880kHz with 700kW, and broadcasts from 1900 - 2200. At 1900 the station opens with a musical signal, but after 2000 has interference from Radio Australia. This is one of the early Russian commercial radio stations, which has been able to continue operating, having picked up sufficient commercial revenue.

SOUTH KOREA: Radio Korea, Seoul is using the RCI transmitter at Sackville and is received on 11,715kHz with English from 1030 - 1100. On Saturday the programme includes a Mailbag session, in which questions from listeners are answered.

UNITED NATIONS: The United Nations Radio for many years provided material for broadcast on the Voice of America, but this was discontinued. Instead, transcription material is supplied to radio stations in many parts of the world. Those tuning to Bhutan on 5025kHz will be aware that on Thursdays there is a United Nations programme at 1430.

There are stations in all continents carrying United Nations Radio, and the transcription material is supplied in 18 languages. The broadcasters include: Sierra Leone on 3316kHz, Sunday 1900 - 1915; Tanzania on 5050kHz, Tuesday and Thursday 1830 - 1900 in English; and Radio Cairo, Egypt on 15,335kHz, Sunday 2030 - 2200 in English. United Nations Radio confirms reception from the New York office for reports of UN programmes heard on these stations. Reception reports should be sent to: United Nations Radio, S-850, New York, NJ 10017, USA.

USA: KVOH Los Angeles operates from 0300 - 0700 on 9785kHz, and 1400 - 0300 on 17,775kHz. English is broadcast on 17,775kHz: 0000 - 0300, Tuesday - Sunday; and Monday 0000 - 0200 and 0230 - 0300. Dr Gene Scott's broadcasts are carried on 9785kHz, 0300 - 0700 daily. WWCR Nashville is back on the air from early May, with one 100kW transmitter on 5935kHz, and heard at 0500. The second transmitter is now on the air using 7435kHz and heard around the same time.

Experimenting

Contined from page 80

Because transistor Q1 amplifies the input signal with a 180° phase shift, we require a second such shift to give us our positive feedback. This is achieved by connecting the regeneration coil with its leads reversed. (Each 'dot' on the schematic indicates the physical top of the coil winding.)

Coil L1 provides the RF load (it offers high impedance to RF frequencies), while R3 limits the DC current flowing through the coil and then the MOSFET. Transistor Q2 is used to match the relatively high output impedance of Q1 to the lower impedance circuitry which follows.

It is connected in the emitter-follower mode (common collector configuration), which performs this high-to-low impedance matching. Realise that the collector is AC earthed via capacitor C7, so it is the common terminal for both input and output.

The rest of the circuit operates as explained in detail last month. Diodes D1 and D2 act as a voltage-doubling detector, and the audio signal is generated across capacitor C10. Variable resistor RV2 acts as a volume control, which determines how much signal is further amplified by transistor Q3 and fed to the speaker.

The decoupling resistor R11, and the capacitors C7 and C8, all help to stabilise the main supply rail voltage. While the operation of a SW radio is as easy to understand as a mediumwave one, designing such a circuit is not so easy, because of the added problems at higher frequencies. Stray capacitances are far more likely to affect its operation, and cause instability.

Imagine the design problems involved with much higher frequencies — like the GHz signals used with satellite transponders! (No, it is definitely beyond the scope of our introductory series to even dream of attempting such a demanding design!)

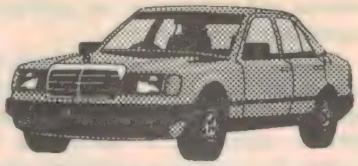
Happy listening!

Transparencies

As usual, a high contrast, actual size transparency (negative) for the PCB used in this circuit is available for only $2. This will allow you to etch your own printed circuit board. This special price applies for transparencies for all projects in this series only. Write to *EA*'s reader services division.

Happy experimenting — and please send us your comments on the circuits we have published, as well as ideas for future projects. ❖

AUTOMOTIVE ELECTRONICS



with MAJOR AL YOUNGER (USAR, Ret.)

Answers to some questions from readers

People who have been in the automotive servicing inductry as long as I have will recognise this truism: if you let a customer talk long enough, they'll tell you what's wrong with their vehicle. This month I'm presenting a selection of letters I've received on basic engine problems (the ones which gave sufficient information to allow a response).

First, a matter of practicalities. Many 'Dear Major Al' letters I've received wrote of shop repair complaints; I really cannot field these, as they are of a legal nature. The best way to select a repair shop is ask someone who has done business with them, or you may contact your state's Office of Consumer Affairs, prior to any transaction. In NSW, If you feel you have a legitimate complaint on a repair, contact MVRIC, on (02) 712 2144.

Now let's look at some of the letters with problems I *can* offer help on.

Pintara barely booms

Mr Brown of Burwood wrote about his Pintara, which has never been the same since he had an air conditioner installed. It has a rough, slow idle, despite having being serviced every 20,000km.

Major Al: You installed an air-conditioner! Is there a wire from the A/C Clutch circuit to the FICD? (See Fig.1 for Pintara parts location) If that wire is not connected, the engine *should* stall or 'bog down', with the A/C on.

The ECU also monitors the A/C power switch, which turns the fan on — is it connected? (See Fig.2: Pintara A/C idle circuits).

Did your idle problems definitely start after installing the 'air'? Here's a hot flash: Some ECU's are different on air-conditioned cars, is yours?

To check whether there are two versions, call the dealer and ask for a new ECU. If he asks "Do you have air conditioning?" assume there's a difference. If there is, and yours wasn't changed when the A/C was installed, I wouldn't be surprised if someone has mucked about with the mechanical idle adjustments and maybe the timing, to perform a 'quick fix'.

Since we're talking about idling problems, I'll digress for a moment. What effects idle? Everything! In my experience, if the engine's integrity is OK, meaning good valves and timing chain or gears, etc., idle problems are most often simple problems. And if someone has worked on it, they likely forgot that the ECU controls running or curb idle.

Furthermore, the ECU idle circuit must be disabled, to check Base Idle, which must be correct. The biggest culprit is one named 'miss adjustment'. Is the TVS (Throttle Valve Switch) correctly adjusted and working? (See Fig.3:TVS Adjustments)

The FICD opens an air passage with A/C on, to increase idle. The ECU controls the IVCV (idle vacuum control valve), which in turn controls idle. So a vacuum problem makes an idle problem.

Another common fault that shows up in idling is the AACV (auxiliary air control valve) — is it working? Does the air regulator close when the engine is hot? (See Fig.4: Auxiliary Air Test)

Returning to Mr Brown's Pintara, let's talk about one of my favourite engines. One of the problem areas is the ignition. Your car has 100,000km on the odometer. It most likely needs a new rotor, cap and wires. Measuring the wire resistance will not tell you about insulation breakdown, which may cause arcing.

Another problem is spark plugs. Yes, I know, the manufacturer states all plugs should be the same heat range. I've had

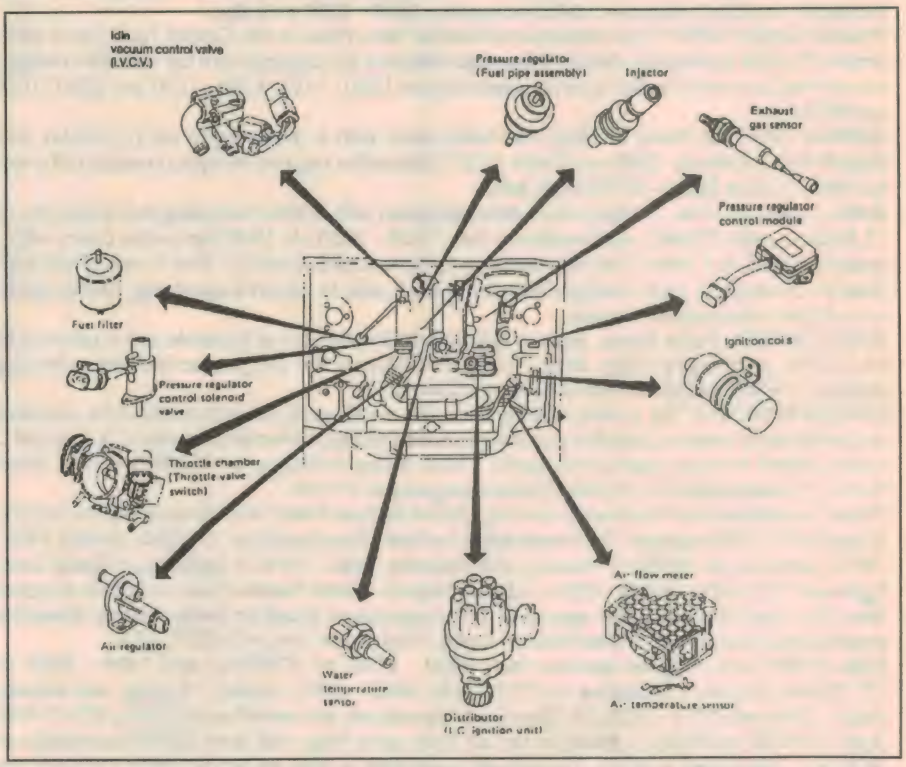


Fig.1: Location of key components in a Pintara, inside the engine compartment.

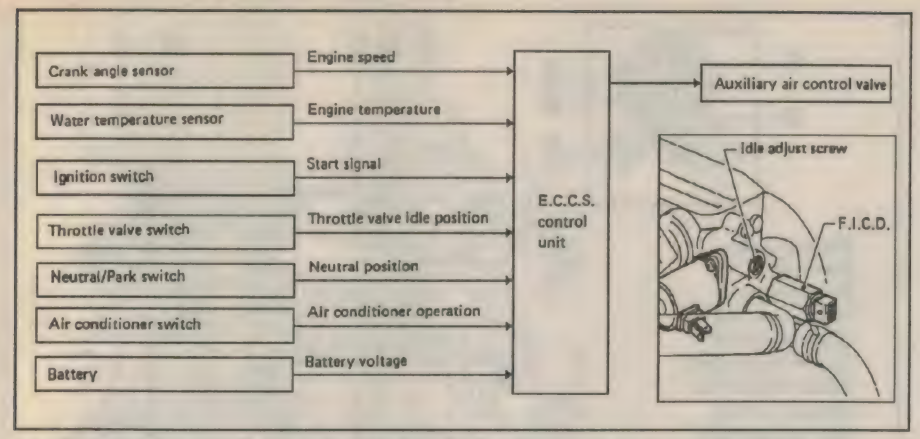


Fig.2: The circuits which affect idling, in a Pintara with air conditioning.

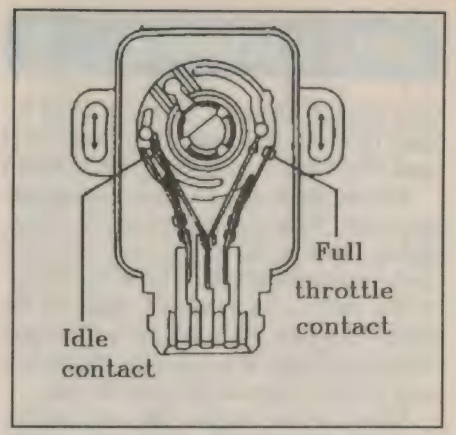


Fig.3: Throttle valve switch adjustments.

better luck with NGK, using two heat ranges: the recommended 'hot' type for the input and the 'cold' type for the exhaust plugs.

But you have an idle problem, so why am I talking about ignition? Because that's where it starts: bad timing or ignition equals idle problems. I have fixed many of these engines by replacing the distributor rotor, cap and ignition wires. Of course, I do have access to an engine analyser to aid diagnosis.

Another area is fuel problems, caused by dirty fuel filters. Have you changed them? How about the screen filter, is it clean? What screen filter? Well, it's at the fuel pump connection. Most often it's on the pressure side. Just disconnect the line at the fuel pump, remove, clean and replace. (But watch out — the line is under pressure!) Many auto tech's don't even know it's there. A dirty filter effects flow, and restricted flow means poor idle and performance.

Finally, Mr Brown, you stated that parts were "...failing regularly", and that you need new ignition leads and a muffler system. That sounds like pressure switch failure, or a corroded connector. A bad exhaust system will effect the operation of the O_2 sensor (not enough back pressure) and burn exhaust valves, if it's exposed to outside air.

Furthermore, what shape is your catalytic converter in? A partially clogged one will almost stop an engine running. An auto tech, with a good engine or exhaust gas analyser, will find these problems quickly. Of course, if the shop you went to doesn't have diagnostic equipment, or does not use it — you went to the wrong place!

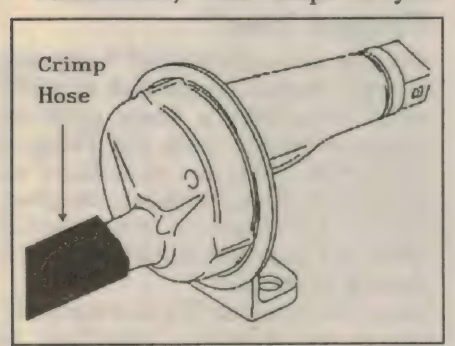


Fig.4: Testing the auxiliary air control valve (AACV).

Bimmer misfires

Rex, from Barmera in South Australia, wrote: "...If I rev my Bimmer over 4000rpm, it misfires. I have it tuned and it runs well for a week. I added a CDI and it ran fine for a week, then gave the same problem. I cannot afford to change plugs every week..."

Major Al: With CDI firepower, it's obvious there must be a fuel problem after start-up. From the information you provided, it sounds like the engine is running too lean and frying the plugs. Check by pulling a few plugs, and see if they're fried.

I assume the ignition system's in good nick with no arcing. I also assume that the air intake system's all in place. If under bonnet air (very hot) is entering the system, this will cause a too-lean condition — as will a dirty air filter.

A common failure on Jetronic systems is the auxiliary air valve (AAV) remaining open after warm-up. This causes the engine to run too lean. If there is no starting problem, I assume it's open when the engine is cold. After warm up, it must close.

To check this, have the engine warm at idle, and crimp the vacuum hose attached to the AAV with long-nose pliers. If the engine changes idle, the AAV's stuck open. (Note: most old vacuum hoses are brittle and will crack when you do this test. Make sure you have a spare vacuum hose available.)

Another common problem is the throttle valve switch (TVS), which is physically connected to the throttle valve. This controls the enrichment circuits. Take an ohmmeter and test from the centre to the left side for continuity. Then push the throttle rod — the circuit should open. Release the throttle rod, and move the meter from the centre to the right side; it should read open. Push the throttle rod slowly towards full throttle. At about 60- 75%, the meter should read continuity. Minor adjustments can be made by loosening the mounting screws and twisting the TVS. (NOTE: A good technician can carefully take them apart and repair them...)

The next check is on fuel flow. Find the fuel regulator — it's on the fuel rail. There's a vacuum line connected. Get the engine warmed up and crimp the vacuum line. The engine should increase rpm — if not, you may have a bad regulator, fuel pump, dirty fuel filter, clogged injectors or a combination of these.

By the way Rex is an electronics technician, so we have a quick test for him: locate the coolant temperature sensor. Pull the lead off; if it's corroded (that may be the problem), clean it. Then attach your resistor substitution box across the lead to earth. (Note: make sure the engine is warm.)

Connect in about 250 ohms, start the engine and let it idle. Now increase the ohms to about 2700. The engine must increase idle — if not, you most likely have a flow problem.

Yes, it could be a bad ECU or even the fuel pump, but I always suspect them last. (Note: if you muck-up and *start* the car with the coolant sensor circuit open, you may flood the engine. I've flooded Bimmers so badly, I had to remove the plugs and blow fuel off the electrodes.)

Now for the fuel filter. (Caution: As I noted earlier, the system is under pressure. The next step is best done with a cold engine, and a small pan to catch fuel.) You need a loop of fuel line with

two clamps. (Note: I also fit a clear in-line filter, in the loop, to monitor fuel and stop trash from entering the system.)

Loosen the fuel tank cap to release any pressure. Then disconnect the fuel line, going towards the engine and catch the fuel in a small pan. Attach the 'fuel loop' to the end you've removed. Remove the other fuel line from the car's filter and attach the loop. Wipe up any spilled fuel and pitch the rags away from the car.

Now start the engine, idle until warm, then crimp the vacuum line to fuel regulator; the engine must increase idle.

Before we condemn the regulator and buy a new one, have it checked — preferably off the car. Most shops equipped for EFI repair can do it. They can also check the fuel pump, as it requires pressure gauges.

The last thing left is clogged fuel injectors. To check for bad injectors, make sure the engine is warmed up. At idle, remove the injector connectors one at a time. The idle should drop by 100-300rpm, as each injector is disconnected. If not, check the signal voltage at the connector.

You can also use a long screwdriver as a stethoscope. Place the handle on your ear, the other end on the injector and listen for it clicking. (NOTE: clicking does *not* mean it's not clogged.)

If an injector fails the RPM test, remove and clean it. There's special injector cleaning machines available. In Sydney, they get $40.00 each for cleaning injectors, out of the car.

Systems that clean injectors in the car may cause cylinder 'wash-out' — they can remove oil from your rings, and cause scoring of the cylinder walls).

Cranky Camira

Larry, from Narellan in NSW, wrote to complain about annoying electrical problems with his wife's car: "My wife went shopping, in her Camira, and experienced trouble with the engine cranking. She went to a service shop and was told she needed a new alternator, which she bought. Next day, I had to jump-start the car..."

Major Al: More batteries, starters and alternators have been sold because of bad connections or cables, than due to any other cause.

Here's a quick test. Take a DMM (digital multimeter), set to say 20V DC, and place its positive probe right on the centre post of the positive battery terminal. Place the negative probe on the connection lug at the far end of the positive battery cable. (See Fig.5) Note that a DMM with a 'Hold' function is preferable, for this test...

Now start cranking, with a cold engine, and monitor the DMM's voltage reading. If the voltage exceeds 0.3 volt (300mV), you have cable or connector problems. If you're not sure of the correct cleaning and maintenance procedures, they're given in my booklet *Maintaining the Electronic Motorcar.*

As it happens, Larry was wise to the fact that a cable problem might be the real culprit. He went on to relate that:

"The positive lead had so much corrosion under the insulation, I had to replace it. I cleaned the other cables and earth connections. My wife has not experienced any more starting problems..."

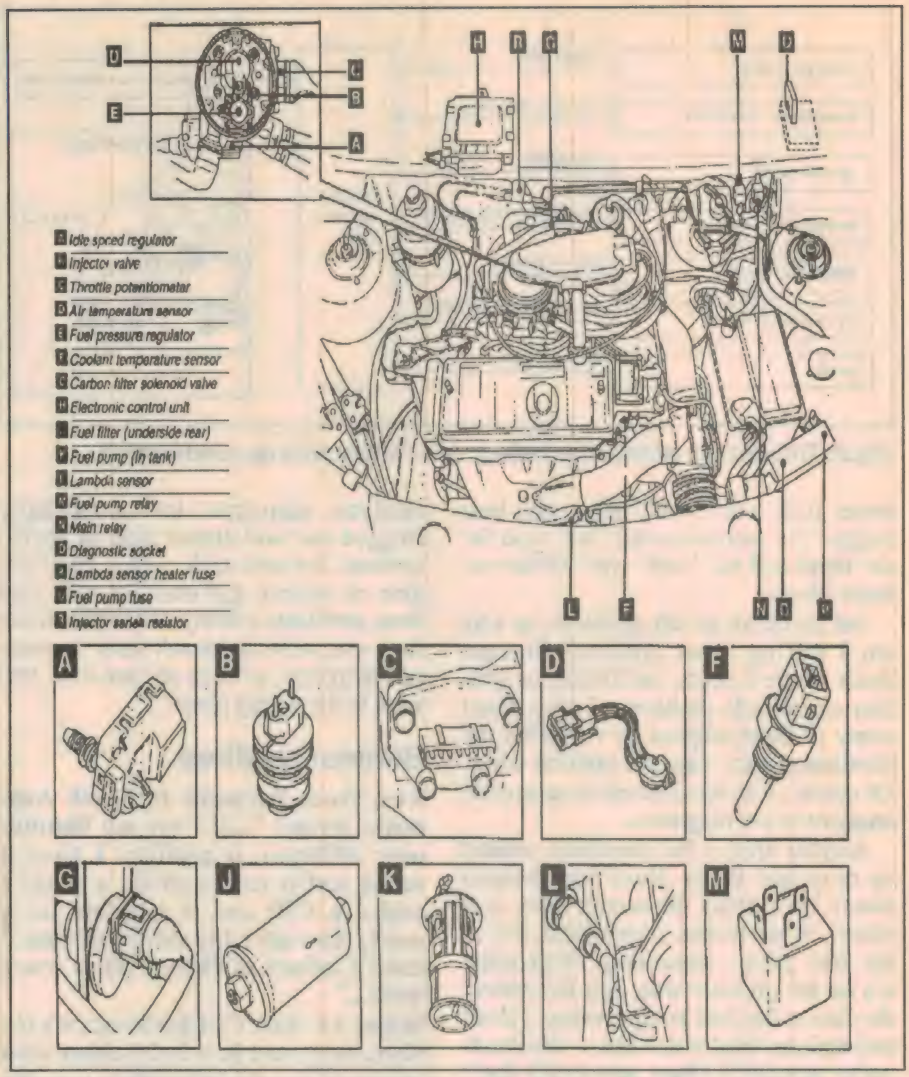


Fig.6: Location of components in a Peugeot 205Si engine compartment.

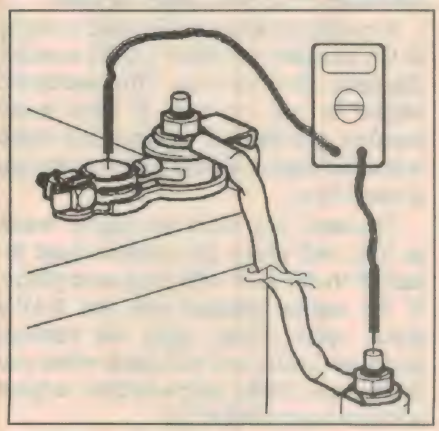


Fig.5: Testing the battery cable and its connections, with a DMM.

Peugeot 'dies'

A reader who calls himself 'Lightning George', from Georges Hall in NSW, wrote regarding a nasty problem which occurred with his Peugeot 205Si: "My 205Si has 'shut down' on me several times. I took it to the place where I purchased it, to no avail. I think my tom cat knows as much about it as they do".

Major Al: It sounds like an earth problem, to me. A sudden 'shut-down' is usually due to loss of ignition or ECU power. Start checking earths...

As it happens, George is an experienced electronics type, who armed himself with a DMM. Under the bonnet, he traced the ignition wires to what he believed was the 'power-up' relay. (It was — see Fig.6) He monitored the voltage with the engine running, at 14.1 volts. But he noticed the voltage would suddenly drop (to about 6 volts), then immediately return to 14.1V. He jumpered the relay contacts and drove back to the dealer's workshop.

As he was explaining the problem, a technician walked by, then stopped and listened. The technician then grabbed the main wiring harness and started unwrapping the tape. He pulled out two wires, and stated "Another one the factory forgot to connect"!

As they say in France, "C'est la vie". I visited Peugeot country in April, George, so I gave them your regards... (But I couldn't fit your cricket bat in my luggage — sorry!)

Complaints dept.

Two readers wrote to express dissatisfaction with my booklet *Maintaining the Electronic Motorcar*. They apparently expected more on adjustments to the electronics, although everybody else seems to be quite happy with the information given.

Major Al: Well, fellas, there is really nothing electronic to 'tweek'. The ECU doesn't require maintenance — although don't spill your beer on it. Some vehicles have a vacuum line to the ECU, which on one occasion was ripped out by an 'ankle biter'. To the many happy purchasers of the booklet, I thank you. The two unhappy people have been sent a refund.

Summarising

I hope this look at some of the problems that have been brought up in reader letters to date gives you some useful information for solving your own. The response to my articles has been gratifying, and for this I thank everyone. The field of automotive electronics is very interesting, challenging — and wide open for new talent.

Of course if you have any further automotive electronics problems that you've found hard to solve, send in the details and I'll try to answer them here in a future issue. In the meantime my booklets are still available. *Maintaining the Electronic Motorcar* is $25.00, the *Code Book* is $35.00 and the *Ford EECIV Manual* is $60.00. Send your orders with remittance to Major Al Younger, PO Box 477, Double Bay 2028. ❖

JAYCAR DEALS FOR AUGUST

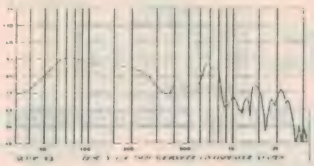
RE/SPONSE STEREO MINI SUBWOOFER

NEW

At last, you can now have subwoofer bass sound at an economical cost. Ideal for use with any smaller speaker system to dramatically increase the bass response.
Ideal for use with: • small bookshelf type Hi Fi speakers • rear speakers for AV surround sound • car Hi Fi systems.
The Re/Sponse subwoofer connects in line with your normal speakers, so you don't have to buy expensive subwoofer amplifiers, cabinets, crossovers, etc.
It is housed in a very smart black cabinet measuring 437(W) x 180(H) x 300(D)mm. There are two high quality drivers in each cabinet - one for each channel. The speaker impedance is 4 ohms, which is ideally suited to both car Hi Fi and Home systems. The subwoofer is connected in-line to the normal speakers via push terminals on the back of the box - in/out for each channel. Simply place the subwoofer on the floor at home, it can even be hidden behind a chair. Ideal for increasing the bass response in rear channels for surround sound systems.

Specifications

Drivers	5 1/4" high compliance
Max Power	100 watts
RMS Power	50 watts
Impedance	4 ohms
Frequency Response	36 - 200Hz
Crossover Network	6dB/octave roll off
Dimensions	437(W) x 180(H) x 300(D)mm
Sensitivity	88dB ±2dB @ 50cm



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2 STATION WIRED INTERCOM

With monitoring indicator

This intercom provides noise free conversation. Either station can signal the other even when the system is off. It can be used as a room/baby monitor, and it sounds excellent.
Features: • solid state circuit • adjustable volume • call facility even when unit is off • hands-free communication on sub-station • operates on 9V battery or 240V plugpack (Cat. MP-3007 $15.95). Supplied with 20 metres of connecting cable and staples. A quality intercom.

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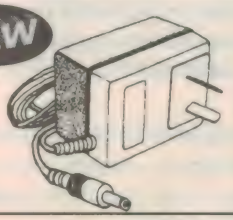
240V input



12V AC output at 200mA. Quality ARLEC brand. SAA Approved. We sell a 300mA for $16.95.
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TV MASTHEAD AMPLIFIER

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• Gain VHF low band 40MHz-80MHz -0 to 32dB±2dB (adjustable by gain control) • FM Band With link -25dB attenuation. Without link -0 to 32dB±2dB (adjustable by gain control) • VHF High Band 120-250MHz -0 to 26dB±2dB (adjustable by gain control) • UHF Band 500-830MHz -15 to 32dB±2dB (adjustable by gain control) • Noise Figure VHF <2dB; UHF <3dB

Cat. LT-3280 **$99.50**

COMPUTER LEAD MADNESS

Consists of a 25D plug one end to a 25D socket and plug on the other end. Plugs are IDC - cable is IDC flat type. Cat. PL-0869

ONLY $9.95

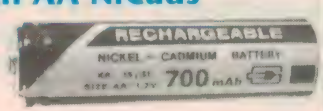
NEW

ADELAIDE STORE MOVED

The Jaycar store in Adelaide has moved from 190 Wright Street to 194 Wright Street. Phone numbers are unchanged.

700mAh AA NiCads

SUPER LOW PRICE



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AA NiCads with SOLDER TAGS 500mA/h

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Speed 70ns Cat. ZZ-8419
10 for $5

SONY DISKS

Jaycar are proud to sell and recommend Sony Disks. Sony invented the 3.5" micro floppy system in 1980. Since then the system has become the world's standard. Every part of Sony's disks are engineered for performance from the inside out. Inside there are Sony's Exclusive High Precision VIVAX magnetic particles, delivering a high signal-to-noise ratio for superior reliability and data integrity. Sony's DDL Binder with lubricant ensures that the micro floppy can take over 30 million passes of the read/write head. The Auto Shutter is stainless steel helping protect against static electricity that can impede performance. The disk liner provides smooth rotation and cleans the magnetic sheet for optimum reliability. And the lifter is made of metal - not plastic - for extra durability.

Sony's Very Own Quality - Performance Guaranteed

Sony's Micro Floppies are not only carefully made, they are also certified for data integrity. To pass this certification inspection, each disk must be completely error free and in perfect working order. Sony's attention to detail also means that the Micro Floppy storage box can take high temperatures (60°C) and high humidity.

Size	Cat	Price (Box of 10)	Size	Cat	Price (Box of 10)
3.5" DSDD	XC-4750	**$19.95**	3.5" DSDD IBM Formatted	XC-4751	**$21.95**
3.5" DSHD	XC-4752	**$32.95**	3.5" DSHD IBM Formatted	XC-4753	**$34.95**
5.25" DSDD	XC-4755	**$12.95**	5.25" DSDD IBM Formatted	XC-4756	**$14.95**
5.25" DSHD	XC-4757	**$21.95**	5.25" DSHD IBM Formatted	XC-4758	**$24.95**

NEW

HAS YOUR TV/VIDEO REMOTE WORN OUT?

Pre-programmed remote now available
Remote controls do wear out.
Depending on your model, you will pay up to $169 for a replacement. This new remote control is pre-programmed with the codes of TVs and videos from 12 different manufacturers. It does not require a remote control to learn from. It's ideal for replacing lost or damaged remote controls at a far lower price than buying the original one. To operate - simply enter in appropriate code for your make of TV or video - this requires pushing 3 buttons.
The brands covered by this are:- JVC, Sanyo, Sharp, General, Sony (R label), Toshiba, NEC, Pioneer, Hitachi, Funai, Panasonic (National) and Mitsubishi.
We cannot guarantee that every TV and video made by these companies will work, but many will. If you find it won't work, simply return it in new condition within 7 days (14 days mailorder) for a refund. (Requires 2 AA batteries not supplied)
Cat. AR-1700

ONLY $39.95 NEW

LETTER FOLDER/MAIL OPENER

Another surplus sccop purchase.
These are made in Japan. If your business/office needs to fold normal A4 sheets to mail out, this machine will reduce expensive labour costs. It will fold up to 3 sheets at a time and folds them twice so they fit into an DL size (110 x 220mm) envelope. It will also open mail. Simply insert the envelope in the slot and it will grasp it and run it through and open it. It will open mail in about 1/2 the usual time taken. 240V operated.
We have seen a similar unit in a stationery catalogue - without the letter opener for $695. We feel that a realistic price for this machine is $399. However, these are only $99. Save about $600???

NEW

Cat. YL-2900 **ONLY $99 SAVE $500?**

1MEG UPGRADE KIT

To suit IBM PC PS/2 Model 30. Consists of 2 x 512K SIMMs. Genuine high quality OKI Japanese brand. Compare our price with 2Meg SIMMs.
Cat. XS-5050

ONLY $69.95 NEW

SAVE ON IN-LINE MAINS FILTER

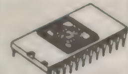
The Jaycar MS-4000 will provide a quick, low cost means of SURGE and SPIKE protection for computers, monitors, printers, faxes, photocopiers, plus a wide range of other micro processor products. It consists of a lead with IEC plug to 240V pluf, two metres long with mains filter in-line.

Technical Specs: Lead 240V plug to IEC plug **Cable** 2 metres long **Material** flame retardent ABS case **Voltage** 240V 50Hz **Max Current** 10A 2300 watts **Total Energy Rating** 40 Joule 8/20μS **Filtering** Surges, spikes **Clamping** 275V RMS **Peak Energy Diverter** 2,500 amps **Protection Type** PN, PE, NE Approved Aust Safety Standards AS3100, AS3105.
Cat. MS-4000

NORMALLY $27.95 AUGUST ONLY $20 SAVE $7.95

USED EPROM BARGAINS

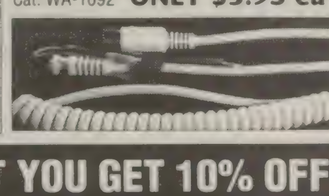
2716	Cat. ZZ-8500	$3.95
2764	Cat. ZZ-8501	$3.95
27C256	Cat. ZZ-8502	$2.95
27C512	Cat. ZZ-8503	$4.95



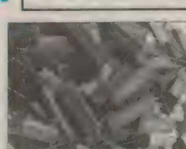
Limited quantities. Buy 10 less 10%.

COMPUTER KEYBOARD / AUDIO / MICROPHONE LEAD BARGAIN

This lead was made for computer keyboards. It is a curly cord, grey in colour and has a five pin DIN plug on one end. The other end terminates to a 5 way SIL pin header plug and the earth wire to a round lug. The lead has an aluminium mylar shield and is about 2 metres long when extended. Ideal replacement for:- computer keyboards, CB microphones, audio DIN to DIN leads, etc., etc.
Cat. WA-1092 **ONLY $3.95 ea**



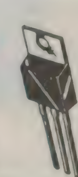
WIREWOUND RESISTOR PACK BARGAIN



Large wattage wire wound resistors are getting rarer every month. We have purchased a large quantity of mainly 7 watt IRH resistors, but there are also some 5W, 10W and 15W. The values range from 1Ω to 8.2k. A typical pack will include many of the following values. 1Ω, 1.2Ω or 2.7Ω, 3.3Ω, 3.9Ω, 4.7Ω, 6.8Ω, 10Ω, 20Ω, 51Ω, 56Ω, 75Ω, 100Ω, 120Ω, 220Ω, 300Ω, 330Ω, 390Ω, 470Ω, 510Ω, 620Ω, 680Ω, 820Ω, 920Ω, 1k, 1.5k, 1.8k, 2.2k, 2.7k, 3.3k, 4.7k, 5.1k, 6.2k, 6.8k, 7.5k, 8.2k.
To buy a range of these today would cost about $90. Grab a pack for that moment in the future when you will need one. Approx 120 resistors supplied.
Cat. RR-3200

ONLY $12.50 per pack NEW

TIP 29C TRANSISTOR BARGAIN



Stock up on these while we have them. Limited quantity.
Specs: NPN, AF power, volts 115, amps 2, watts 30, case TO-220. Normally about $1.50 ea.
Cat. ZT-2281

$5 for packet 10

JAYCAR WHERE IF YOU BUY 10 OR MORE OF ANY PRODUCT YOU GET 10% OFF

"NO FREE LUNCH" TELEPHONE SALE

WHAT YOU SEE IS WHAT YOU GET - BUT NO MORE

Jaycar has secured a quantity of telephone products that are virtually new, but cannot be sold as new. The goods have been returned to the distributor, ATD for one of the following reasons.

• "Wrong colour" • "Don't like it" • "Too hard to operate" • "Unwanted gift" • "Faulty" • "Etc., etc!!"

Nowadays the large chain stores take goods back "no questions asked". When the goods go back to the distributor, the carton is usually missing or they may have a scratch or no instructions, etc. The goods can no longer be sold as new. Jaycar has done a deal where the goods are repaired (if, but hardly necessary), cleaned, repacked with all accessories, instructions, etc. But not in the outer carton, just shrink wrapped in the styrene packing pieces.

We have purchased these goods at a massive discount over normal wholesale! They are perfectly OK if you want one of these for yourself. They really do not make gifts - the recipient will think that you are a cheap skate!

THE DOWN SIDE

The goods are NOT new. Someone has had them before you. They DO NOT carry a 12 months warranty as MAY appear in the instructions inside. If you want a product with a full warranty go to the big shiny store in the main street and pay up to twice as much. The warranty is 30 days over-the-counter replacement. We will not have this stock in 12 months, so we won't be able to replace it then. But realise this, if the gadget works first up it is likely to work indefinitely, electronics is like that. Repair afterwards. We still stand behind our products. For $25 + freight we will fix the following for a six month period Cat. YT-7080, YT-7082, Answering Machine/Telephones. The others are too cheap to fix! That's right, no free lunch, what you see is what you get.

THE UPSIDE

We've done this deal with ATD before. We have experienced a lower fault rate with rework stock than new stock. Whilst someone has had the stock before you, it was for only a short while usually no more than days - see 'reasons'. The products shown below are far, far cheaper than the cheapest discount house in Australia for the equivalent new stock. Check yourself. So that's it. Make up your own mind.

TELEPHONE CLOCK/RADIO

The ATD Model 3550 is packed with features:

They include:- **Telephone** • 10 memories • Last number redial • Save memory • Tone/pulse switchable • Ringer volume on/off control • Recall key (for PABX) • Wall or desk mount **Clock Radio** • AM/FM radio • Large green display • Brightness control for display • Automatic radio muting when using phone • Battery back-up for time and alarm • Wake up to alarm or music • Snooze function for alarm • Sleep function. Re-worked stock. 30 day exchange warranty. No fixee after that.

Cat. YT-7086 **WAS SELLING FOR $69.95**

A BARGAIN AT $32.95

BUSINESS PHONE FOR HOME OR OFFICE

These phones were selling for over $100 and are used by many Police Depts. It is PABX compatible, offers off hook dialling with speaker volume control. Also includes last number redial up to 32 digits, tone/pulse dialling, ringer volume switch and mute button.

It also has a light which illuminates when the phone rings making it ideal for the hearing impaired. Plugs directly into your home wall socket. Re-worked stock. 30 day exchange warranty. No fixee after that

Cat. YT-7062 **WAS SELLING FOR OVER $100**

AMAZING PRICE ONLY $29.95

COMBINED TELEPHONE AND REMOTE ANSWERING MACHINE

The Phonewatch 1840 is a compact combined unit offering a host of features. It is ideal for the home and office. In the office it will connect to the PABX system and take messages when the office is empty.

Telephone features: • 20 memories • Last number redial • Tone/pulse switching • Ringer hi/lo/off volume control • "Easycall" compatible • PABX compatible • Pause function for PABX • Mute function • Handsfree dialling • Wall or desk mount

Answering machine features: • Answer calls or provide announcement only • Answer on 2nd or 4th ring • Voice activated recording • Variable length outgoing message 3 secs - 2.5 minutes • Variable incoming message - up to 3 mins • Call screening • 2 way recording of telephone conversations • Memo recording • Remote turn on

For remote operation use a touch phone or our Tone Dialler - Cat. YT-6155 - half price at $9.95. Supplied with mains plugpack, telephone lead, tape and instruction manual. Warranty - 30 day replacement. For next five months special repair price $25. Re-worked stock.

Cat. YT-7080 **WAS SELLING FOR $349 ONLY $99.95**

SLIMLINE TELEPHONE

These were in our 1992 catalogue at $49.95. Features include:-

• Illuminated keypad (no batteries required) • Flash button • Wall or table mount • Pulse/tone selectable

There are 3 colours available - red, navy blue and white. Please specify colour, if sold out we will supply the colour we have.

Re-worked stock. 30 day exchange warranty. No fixee.

Cat. YT-7060 **WAS SELLING FOR $49.95** **NOW $19.95**

COMBINED TELEPHONE AND REMOTE ANSWERING MACHINE

The Phonewatch 1830 gives you the benefit of the following features:-

Telephone: • Last number redial • Tone/pulse switching • Ringer on/off • Wall mountable

Answering machine features: • Digital recording of outgoing messages • Remote turn on/off • Toll saver feature • Memo recording • Call screening • Voice activated recording • One touch playback • Built-in microphone • Two-way record • Remote access to play incoming messages • Message indicator • House monitoring • Call breakthrough - priority breakthrough. Supplied with mains plugpack, telephone lead, tape and instructions. Re-worked stock. 30 day exchange warranty. For next 5 months special repair price $25.

Cat. YT-7082 **WAS SELLING FOR $199 ONLY $89.95**

TELEPHONE CLOCK RADIO

The price is so low, we must be mad!! Buy 2, one as a spare!

Features: **Clock Radio** • one touch control buttons • large radio on/off selector • wall or desk mountable • large LED clock with display • PM/alarm indicators • rotatable clock display • LED radio tuning indicator • battery backup • wake to alarm or radio • automatic radio muting for incoming calls • radio music on hold • snooze facility **Telephone** • ringer on/off • ringer indicator • mute & last number dialled functions • 30 day exchange warranty. No fixee after that. Reworked stock.

Cat. YT-7084 **WAS SELLING FOR $39.95**

ONLY $19.95

MAGNAVOX 12W SENSATION

We have purchased a quantity of the fabulous Magnavox 12W 12" speakers at a special price. This speaker is stocked by us and normally sells for $59.95. We have been able to slash the price to $39.95 a saving of $20.

Speaker Details

• Paper cone, foam roll surround, high temp 25mm voice coil, 350g Barium magnet. Power handling 80W RMS. Frequency range fo - 6000Hz, sensitivity 89.2dB/W/mt. Resonant frequency 25.7Hz. QMS 3.24, QES 1.12, QTS 0.83, VAS 362.1L. Two box sizes - both sealed.

VOL (Litres)	50	100
Tuning Freq	73.8Hz	55.2Hz
Response Peak	6.01dB	4.13dB
-3dB Frequency	49.9Hz	38.6Hz
Qtc	1.93	1.52

Cat. CW-2122

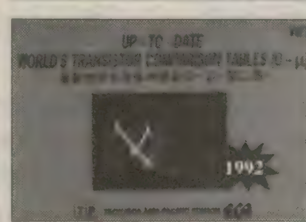
WAS $59.95

NOW $39.95

SAVE $20

WORLD TRANSISTOR COMPARISON TABLES AND DATA BOOK BARGAINS

Save a fortune over normal catalogue prices which are $18.95 each volume. Everybody with anything to do with electronics should have these two volumes and at this special price grab a set now. There are two volumes which we believe are infinitely better than others. Many substitutes listed are in the BC XXX range which are commonly available. Each page is divided into three sections:- The description part with the columns - type, material, polarity and description of application. The data part with the most important ratings , divided into clear columns, and a drawing of the corresponding case with the connection sequence. The alternative - type part, listing, as as possible, the most suitable alternative types.



VOL 1 (A - Z)

Contains more than 11,000 different transistors and FETs. 270 pages. Size 215 x 147

VOL 2 (O - μ)

Contains more than 15,000 devices including 2N, 2SA, B, C, D, 2SK, J MOSFETs and more.

VOL 1	Cat. BM-4584	**$18.95**
VOL 2	Cat. BM-4585	**$18.95**

BUY BOTH FOR $20

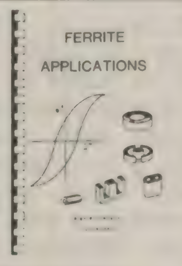
ALUMINIUM BASKET HIGH PERFORMANCE SUBWOOFERS

These are especially designed for subwoofer applications with • High output levels • Increased cone excursion limits • High performance roll surround and suspension system • High power handling capabilities • Large magnets • Polypropylene cones - woven stamped for extra rigidity • Designed to work correctly in relatively small enclosure sizes • Special designed solid frames to increase strength and rigidity of the suspension system • Kapton insulation voice coils offer better reliability at higher voice coil temperatures improving speaker life

SAVE $10 on catalogue price

6" 60W RMS	10" 100W RMS	12" 150W RMS
Cat. CW-2162	Cat. CW-2166	Cat. CW-2168
$79.50	**$119**	**$149**

FERRITE MATERIAL & APPLICATIONS BOOK



This is one subject that is very difficult to find any information on. Magnetic cores are the foundation for transformers, inductors and chokes used in so many of our electronic projects. This book is intended to be used by persons who want to (or have to) work with ferrite materials, but are not well versed in magnetics or ferrites and cannot justify outside consultation. Some of the problems addressed are:- • How to select the right type of material • How to identify an unknown material • How to measure material properties and much more. Written in 1991 by A. K. Johnson.

Softcover, ringbinder. 82 pages 212 x 132mm. Cat. BC-1125

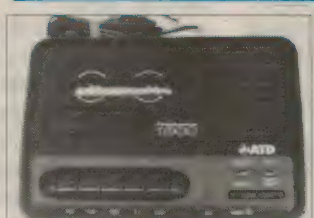
NORMALLY **$18.95 AUG SAVE $5 ONLY $13.95**

BARGAIN PRICED ANSWERING MACHINE EVEN CHEAPER!

The ATD 1800 is a very popular answering machine. All the big stores and discounters normally sell if for $99. These are in our catalogue for $59.95 and we have sold hundreds. Features: • Digital recording of outgoing message • Memo recording • Call screening • Voice activated recording • Built-in microphone • Message indicator - number of calls. We've been able to further reduce our price of this machine. Supplied with instruction manuals, phone lead, and power plugpack. 3 month replacement warranty applies to this product. Probably Australia's best selling machine.

Cat. YT-7028 **ONLY $49.95** Reworked Stock

JAYCAR - No. 1 FOR NEW PRODUCTS



3.5mm EXTENSION LEAD

This lead has a 3.5mm mono plug on one end and a 3.5mm socket on the other. It's 1 metre long and grey in colour and the cable is shielded.

Cat. WA-1026

ONLY 50¢ each

Jaycar ELECTRONICS

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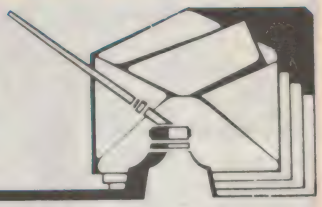
Information centre



Conducted by Peter Phillips

What readers say about EA

We examine the question of magazine content this month. What do readers really want? As well, there's more on the Inductance Adaptor project, some comments on the May What?? question and the usual reader comments on matters various.

Many of the letters we receive include suggestions on the content of the magazine. Some tell us what's wrong, others what's right. But do these letters ever agree on what *EA* should include? Is there a magic formula that we should follow to guarantee satisfaction among all our readers?

I thought it would be interesting to depart this month from our usual fare and to instead air some of the views readers have expressed over the last 12 months about content. While we get quite a lot of letters complimenting us (thank you!), you're probably more interested in what others think we do *wrong*. The first letter (edited somewhat) is fairly general, but the writer makes quite a few good points...

What's wrong with *EA*

I don't consider myself a brilliant technical person, but rather someone who is always wanting to know how it works. I want to let you know why I only buy your magazine very infrequently, and what I would like to see in it.

Basically, Electronics Australia doesn't cover things I'm interested in, or at my level, unlike a magazine called Talking Electronics. I built their Z80 microprocessor unit and some of the add ons. I'm sure quite a few people learnt a great deal about the Z80 and computers in general from this excellent project.

But one of the greatest let downs with any magazine is promising a complete project then failing to follow through. This happened with the ETI 660 computer some years ago, and I made a pledge never to buy the magazine again.

What I would like to see in EA is a computer course (for IBMs) describing how to interface it to the outside world. Also, a GWBASIC programming course for interfacing. I know it's old, but it's a start! Included with the computer course you could explain things like TSR programs (a real mystery to me), PAL technology, DOS for beginners, 8250 and similar programmable ICs and assembly language programming.

In other words, forget about whether it's the average value or the RMS value of a sinewave that does the work — it still gets hot doesn't it? There are many issues that are more important! (D.S., Roselands NSW).

So obviously D.S. wants more on computers and their add-ons. And he's not alone, although there's disagreement on the type of computer.

Computer projects, please

I own a Commodore 64 computer and to my disappointment I have never come across any project for this type of computer. (I read your magazine regularly). There are three main things I'm looking for:

- *32K additional RAM able to be disconnected from the cartridge port without losing its contents (battery backup).*
- *EPROM programmer where you could use it like a disk drive (save, load), not just for saving and erasing under UV.*
- *Short Wave Listener and Talker, so the computer could communicate with other computers in Morse code.*

(P.C., Candelo NSW).

And another letter from a reader who is quite passionate in his views:

I have been reading EA for some time now, and have noted much to my dismay a lack of computer projects. Your 8051 microcontroller project in February was a step in the right direction, but the article could have gone into more detail. Perhaps 'modules' such as ports, a speech synthesiser, input/output interfacing could be presented to allow the unit to do special tasks. Perhaps EA could run a course in assembler, which would be useful to many readers, including myself!

Keep up all the great projects, especially computer ones. It is in computers that the future lies, and projects for computers and stand-alone projects on such chips as the Z80 and the 8051 are vital. (J.L., Chapel Hill Qld).

I have other similar letters in my file, so it's obvious there's keen interest in computer based projects. But not everyone agrees...

I'm fed up with stupid computer projects. Who would really want to control their garden sprinklers with a computer, except maybe a high-tech nursery owner with too much money!

Don't misunderstand me on computers — I think they're great. It's just that the days of the 8-bit Apples and all those 'simple' computers are gone and the cost of doing anything useful is beyond the hobbyist. Sure, have your 'computer programmable' signal generators for those who want to learn about computers. Your Universal MIDI Interface was great at the time, but these days MIDI interfaces are almost given away in breakfast cereal packets.

Instead, give us projects that don't have 40-pin programmable monsters. And if you must have computer projects, don't assume everyone has an IBM. I still use a Microbee 256TC, a Z80 machine with no hard disk! (S.A., Moorabbin Vic).

The topic of computer projects is perhaps the most controversial. Looking back over the last few issues, I think we've catered well for computer owners. The Teletext-computer interface (June), the 68705 programmer (March), an 8051 microcontroller prototyping board and a DSO Adaptor for PC's (both in February), and a PC-controlled Frequency Synthesiser last month.

There are more computer type projects

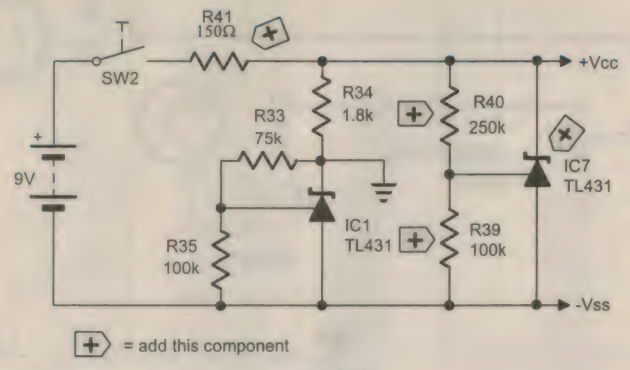


Fig.1(a)

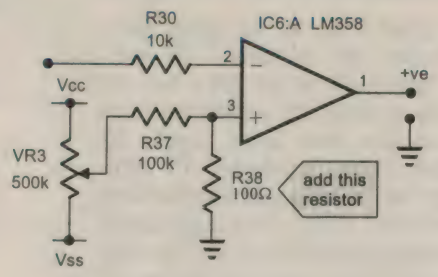


Fig.1(b)

in the pipeline, and there's a regular section nowadays called Computer News and Products devoted to computer peripherals and articles about computer related equipment.

But this doesn't suit those who *don't* want computer projects, of course. So what projects do *these* people want?

Other projects

Many readers offer project ideas, and I often include these suggestions in the column in case other readers can help. Suggested projects have recently included a guitar amplifier with contemporary technology, a means of measuring brain waves and a darkroom timer with big digits.

The main areas of interest in project construction are (basically): automotive, audio (or music), computer based (of course), test instruments, communications, novelty and general. The general group covers all those projects, such as battery chargers or fluorescent light inverters, that don't fit the other categories.

And what are the important characteristics of a project? Talking to kit suppliers gives some idea. Paramount is cost or value for money, next is usefulness. Complexity is not always a real issue, particularly if the project is sold as a kit with a silk-screened PCB.

But the truth is, there is no real way of determining what *everyone* wants, as our readership covers such a broad range. The next letter sums this up rather nicely.

What's the emphasis?

Is there a predominant emphasis on subject matter at EA? It seems to me that as a young boy of 13, the emphasis was on hi-fi stereo kits and has evolved through radio based subjects, to novelties and toys at times, some areas of instrumentation at others and recently to a 'broadband' approach involving a little of everything.

Is the search always on for the perfect balance of subject matter to maximise readership? If so, perhaps a return paid survey sheet would be in order, to see how many readers are kids, hobbyists (big kids), engineers, technicians or nostalgia buffs.

For myself, I can't develop a firm opinion of the current format, which juxtaposes 6V6GTs and DDS technology, Liberal Party policy dangers and requests for junked radio sources. I'm happy to scan it all, but I wish I had time to 'get dirty' a bit more often. (I.R., Pearce ACT).

I.R.'s letter raises quite a few issues, apart from projects. After all, projects represent only 20% or so of the magazine, so it's pertinent to perhaps look briefly at other parts of the content material.

For starters, magazines like *EA* find that readers prefer articles that don't indulge in too much nonsense. We therefore limit ourselves to occasional humour and the annual April Fool's article. But even then, we get letters...

Digital speakers

Like many hacks, I yearn for fame and fortune as a 'writer of fiction' and for practice I often pen the April Fool's article. My most recent was April 1992 (Tom Moffat beat me this year!), where I used the pen name of D.E. Morgan (from DeMorgan's theorems fame). The article was a total fabrication on the concept of building digital speakers. That is, feed in a binary number and out comes sound. But it seems I made it too believable!

While this article has a number of major errors, it appears that the fundamental principle of digital speakers described may have some merit. In order to improve the performance of the digital speakers I would suggest that Mr Morgan makes the following modifications to his system...

What follows is an apparently serious discussion on modifying the construction, including using DC as the fundamental sound source. Unless I haven't got the joke on the joke?

Of course, injecting a bit of light-heartedness into an otherwise serious article generally seems to be quite acceptable, and you'll notice we try to do this.

Nostalgia

An occasional complaint is the amount of 'old-days' articles we run. Of course there are those who want these articles, and one of our most successful one-shot books was a reprint of Peter Lankshear's Vintage Radio articles. Some readers criticise historical articles, such as those by Neville Williams, while other readers want more. But if you add up the amount of nostalgia in each issue, you'll see it comes to a small percentage of the total. Here's what one reader has to say...

I've been reading EA for nearly 40 years and I've never written to you. I'm writing now because I want to say how much I enjoy Neville Williams' articles. It's good to know that EA is recording the story of all those talented people who have played a part in the development of electronics.

I'm not interested in vintage radio, nor in your projects. Also I find anything with microprocessors quite a mystery, but I enjoy reading The Serviceman. Keep up the good work. (O.C., Parkholm SA).

The Serviceman

This is perhaps one of our most popular columns. The subject matter is usually around TV sets or VCRs, but as the next writer points out, does this have to be the case?

Your Serviceman section is my favourite, as it is 'real world'. Unfortunately I don't know much about TV sets, nor do I have any real interest in servicing them. I wonder instead if the serviceman could sometimes talk about fixing radios, tape recorders and other domestic appliances. Perhaps a washing machine or a microwave oven. I'm sure he or his friends have fixed things other than VCRs and TV sets. (F.B., Cronulla NSW).

INFORMATION CENTRE

Good point F.B., as it's quite likely many readers are 'armchair' TV technicians, interested in the story but not necessarily in the actual appliance. However I wonder how many people fix radios these days, or whether TV technicians get involved in washing machines and microwave ovens. And importantly, many readers probably look to The Serviceman section for ideas. As you say, it's real world and the methods used to find a fault are usually transferable to most types of electronic appliances.

Other comments

Most comments made by readers about the magazine are more or less an afterthought, in a letter about something else. We all come in for a share of the criticism, and for that reason the magazine is an ever-evolving thing.

A common comment about mistakes is 'pity the young readers who are being misled by your incompetence'. Fair enough, although I think this sort of comment is a bit over the top. Mistakes are a fact of life (we're only human), and there's not much we can say.

But not all comments are critical. Some are constructive, like this one...

As far as prizes are concerned for questions like the What?? in Information Centre, why not consider giving away subscription extensions. It need not be a full year extension, perhaps three or six months. (S.C., Balcatta WA).

In fact, incentives are offered at regular intervals, ranging from competitions to subscription offers. However, perhaps it would be nice to have an incentive such as that suggested by S.C. — we'll see if it would be possible.

We could go on forever discussing the magazine content, even to the extent of a reply-paid questionnaire as suggested by a reader. Reader surveys are sometimes conducted by magazines, but the results are often ambiguous and unreliable. For this reason, we prefer to rely on regular comments from readers, advertisers, kit suppliers and industry contacts.

Reader letters are an important part of the vitality of the magazine, so be assured your letters are always read and if possible acted on. It might take a while for a reply, for all sorts of reasons that don't really matter (although the main one is the fact that generally we're in overload).

So if you are inspired by the preceding to make a few comments about the magazine content, please take the time to send them to us. Now to other issues...

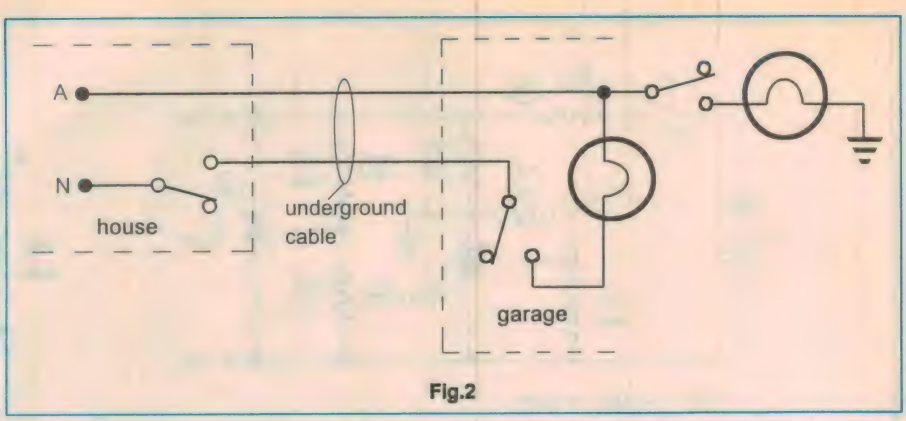


Fig.2

Inductance adaptor

This popular project (December 1992) has caused a degree of angst with constructors, despite the errata published in February 1993, page 44. Because of the popularity of the project, we have decided to repeat the errata and to include circuit diagrams showing the revisions. Hopefully this will help those readers who are having difficulty getting the project going.

A common thread in letters about the problems with the project concerns the power supply section. As you can see in Fig.1(a), the revised power supply regulator circuit includes another regulating stage, improving the stability of the circuit. If you are having overall difficulties with the circuit, start by modifying the power supply section.

The other difficulty you'll have is adjusting the DC offset. To remedy this, add a 100 ohm resistor from pin 3 of IC6 to ground, as shown in Fig.1(b).

These two modifications were described in February 1993 and in case you haven't seen it, here's the rest of the errata on this project. Capacitor C3 is a 1.2nF, not a 330pF and it should be a polystyrene or polypropylene type for best stability. Electrolytic cap C8 is also shown reversed in the overlay diagram.

The output on the 'low' range is 0.1V (100mV) for an inductor of 1mH, not 1V as stated in the article. The nominal voltage at test point A is around 1.5V p-p, varying inversely with frequency when the inductance calibration is correct.

May's What??

I've received quite a few solutions to the May What?? question, which was about a switching circuit for a number of lamps. Most answers included a diode bridge and additional diodes with the required switches.

However, I'm including the circuit sent by a 15 year old reader (J.F., no address included). This circuit is shown in Fig.2 and as you can see it doesn't use diodes. Whether it's legal (or safe) is another matter, but it's certainly simple!

There's been quite a few other letters on the same topic, such as the following:

Naughty unsafe answers suggest themselves, if one assumes an earth connection between the house and the garage — giving in effect a three wire system. But let's think about safety.

Anybody who installs a 2-wire (that is, no earth wire) underground system and who also uses remote switching to control a light in a garage (without a local switch in the garage) must have used 32 volts. (Or maybe it's a 12V battery supply. Whacko! No bridge rectifier).

Who said it was a 240V AC system anyway? Perhaps that's what you meant by a 'bit of lateral thinking', although your A and N labels do seem to imply a 240V AC supply. (R.V., St Georges Basin NSW).

Thanks R.V., for making the point that a 2-wire underground supply should be limited to 32V. But you might ask why you have to earth a bayonet socket lamp fitting. These days, the SAA wiring rules require all lamp fittings to have an earth wire connected to the socket, regardless.

But *is* it dangerous not to have such an earth wire? Probably not, and wiring done before this rule came into effect is not illegal.

It's probably obvious to most readers that the circuit offered by J.F. is not only illegal, it's potentially lethal. J.F. is using the ground as the return, based on the premise that the supply installation uses

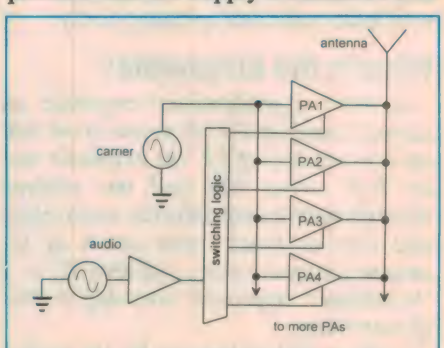


Fig.3

the MEN (main earth neutral) system. The problems here are akin to a hair drier being dropped in the bathtub while you're having a bath.

Electricity will always take the path of least resistance. So if you put yourself in parallel with a conductor and if your resistance is similar to that of the conductor, you'll get a fair share of the current. This can happen in J.F.'s circuit, where simply walking barefoot near the garage (while the light is switched on) can put you in parallel with the conducting path to the earth stake.

Using an earth wire doesn't make things any safer, either. While the earth wire is intact, there's no safety problem. But if the earth wire becomes disconnected from the earth stake, (or if the ground around the earth stake becomes dry and high resistance), the earth wire will reach mains potential. Because all appliances in the house are earthed, they become a potential death trap.

Sorry J.F., it's a simple solution on paper, but one you should *never* use in practice!

But it seems the answer given in June is not to everyone's satisfaction, as the next letter makes clear.

The answer to the May What?? question was featured many years ago in a 'trade' magazine. But, as then, two problems appear.

Firstly DC is introduced in the mains (frowned upon), and secondly the switch mentioned (Clipsal 30MI) is rated for AC only. This type of switch can and does burn up quickly on DC applications, with sometimes spectacular results, especially at 240V AC. (J.S., Middleton SA).

I don't agree, J.S. Firstly, the only DC in the circuit is the current in the wiring to the garage. Otherwise the rest of the mains wiring has the usual AC, as a full-wave rectifier is used to give the DC.

The 30 series switches are rated at 10A, 240V AC. If 100W lamps are used in the circuit, the maximum DC current the switch has to handle is less than 1A. While arcing is greater with DC than AC, I doubt if a 10A AC rated switch will burn up with a direct current of 1A. Perhaps the contributor of the question might keep us updated, regarding switch life.

Water speedo

Last month a reader wrote about an electronic 'log' used to measure boat speed. This followed a letter by our old friend R.V., who proposed the idea in January. But it seems the idea has been in use for quite a while, as our next correspondent points out.

With regard to the article in January by R.V., I'm writing to let you know the Navy has used this method of measuring the speed of vessels for at least 30 years. The log comprises a brass, airfoil shaped rod which can be raised and lowered from inside the vessel. Fitted to the bottom of this rod is a fibreglass section which has a coil inside it and two electrodes, one on each side, in contact with the water.

The coil is energised with a sinewave signal (at 400Hz I think), and the resultant signals picked up by the electrodes are fed to an amplifier.

These EM (electromotive) logs are a great improvement on the old pressure type mentioned in the article, but they have two problems. They don't work in fresh water and the signal reverses when the vessel goes astern. The latter was quite a problem as the servo drives had a stop at zero knots and the log had to be turned off. (S.H., Carindale Qld).

Given that this idea has been around so long, it's surprising it hasn't been developed into something for small boats, as R.V. originally described. Is it because it only works with salt water, or is it too expensive?

Toll barring

In February I included a letter from a New Zealand reader who wanted a toll barring device to prevent others using his phone to make long distance calls. The next letter (also from New Zealand) might have the answer...

In New Zealand on the computer telephone exchanges you can get toll barring on 0900 numbers to stop children ringing up telephone games. You can also get normal toll barring where the person that pays the telephone bill has a personalised number to remove or restore toll barring.

On a similar topic, because you're not allowed to connect anything that's not approved to the Telecom line, I wonder if anyone has thought of developing a 'black box' (approved of course) that interfaces between the phone lines and a non-approved device you want to connect to the phone lines. This way projects described in a magazine like EA could be legally used on the phone system. You could also add a few features to the box, like having a buzzer that operates if a phone is accidentally off the hook. (E.R., Ellerslie NZ).

Thanks E.R., I hope G.H., who first made the enquiry is reading. Regarding your suggestion for an approved phone line interface, there is already such a thing, called an LIU (line interface unit). These are currently available, although they probably don't have the extra features you want.

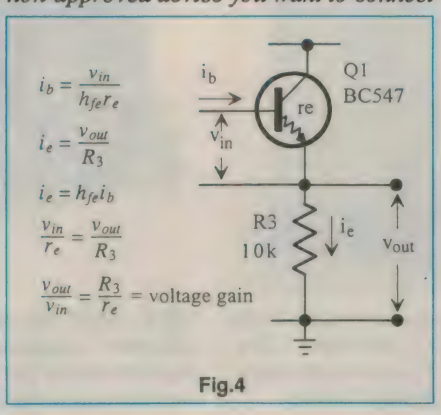


Fig.4

What??

This month's question is more a Why?? than a What??. It goes like this...

These days, some AM radio stations are fitted with the Harris digital transmitting system. The block diagram of the system is shown in Fig.3, where each RF power amplifier (PA) is switched by digital logic controlled by the modulating signal. If the modulating signal calls for an increase in amplitude of the carrier, the digital logic will switch one or more PAs to increase the output power of the carrier going to the antenna. It's true amplitude modulation, achieved by switching some 40 or more PA's, giving an efficiency of something around 85%.

Now, in a conventional amplitude modulated system, the RF carrier is mixed with (or modulated by) the audio signal, giving a complex set of frequencies called the sidebands, with the carrier smack in the middle. In the Harris system, all that's happening is the amplitude of the carrier is switched. The audio signal doesn't even come near the RF carrier, other than through a complex digital switch.

The question is, how are the sidebands produced? If you don't believe the system works, listen to 2UE or 2SM (Sydney). Other stations in Australia also use the Harris system.

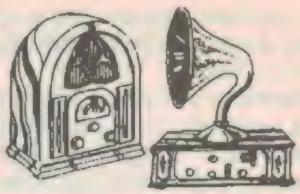
Answer to July's What??

The theoretical answer is 3.6V. In practice you'll probably get something a little lower, say 3.3V. Although it looks like an emitter follower, the circuit actually has the gain of a common emitter amplifier with a gain of R3/re, where re = 30mV/I_E (I_E in mA). The proof of this is shown in Fig.4.

The approximate value of I_E is (V_B-0.6)/R_E, or about 5.4/10k, giving 0.54mA. This gives a value for re of around 56 ohms. The gain is then 10k/56 = 180 (approximately). By the way, the circuit is used in hearing aids as it gives a high gain with minimum components. ❖

Vintage Radio

by PETER LANKSHEAR



The Telefunken Arcolette 3W

In 1903, German radio pioneer Count von Arco, with Professors Braun and Slaby, established the Telefunken wireless telegraph company. Telefunken, which literally means 'distance spark', rapidly came to be a world leader in radio technology and was represented in Australia and New Zealand by AWA. Their compact Arcolette 3 receiver of 1928 was an innovative design, and the fore-runner of the famous *Volksempfanger* or 'People's Radio'.

Telefunken became involved in all aspects of radio engineering — including, with the advent of broadcasting in the 1920's, the manufacture of domestic radio receivers.

In 1928, Telefunken issued a catalog of domestic radio equipment, celebrating their 25th anniversary. My reference copy, kindly lent by John Stokes, was originally distributed by Scott and Company of Queen Street, Melbourne. It lists loudspeakers, battery eliminators and six receivers — ranging from a simple little 'no cabinet' three valve battery powered set with plug-in coils, moveable for control of regeneration, to a five valve plus rectifier mains powered neutrodyne.

Intermediate in the range, and obviously named after the founder, were the three valve 'Arcolette 3' battery model and the subject here: the 'Arcolette 3W', its mains powered counterpart.

Compact & simple

The Arcolette 3W is almost a cube, and compact — measuring only 200 x 200 x 240mm. The case has sheet metal sides, a Bakelite hinged lid and wooden base. There is no internal loudspeaker and the controls are simple, with only two thumbwheels and a slide switch visible on the front panel. On/off buttons are inside the cabinet.

Although the circuit is almost primitive, construction is typical of German-made equipment: innovative, and with considerable attention to detail and finish. There is no chassis, but instead all components other than the power supply are mounted on or under a small bakelised paxolin panel, which could almost be the forerunner of today's printed circuit boards!

However rather than being the familiar etched foil of the modern printed circuit, the 'wiring' is stamped out of thin hard sheet copper and rivetted into place. Tabs and lugs are formed in the stampings at appropriate positions, to provide mounting clips for capacitors and resistors, and to form the spring contacts for the valve pins. There are no separate sockets.

Three tuning ranges

The two coils are of the diamond weave 'spiderweb' pattern, popular in simple receivers during the early days of home construction but perhaps not so common in commercial radios. Although they have a substantial external field, spiderweb coils have the advantages of space savings and efficiency. A simple slide switch selects coil taps to provide three overlapping tuning ranges, from 200 to 2000 metres. In modern terminology, this is from 150kHz to 1.5MHz, and

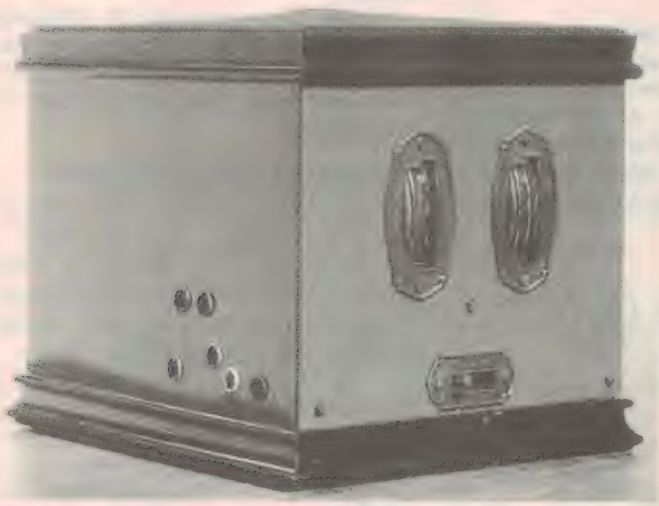


Fig.1: In 1928, radio cabinet fashion was in transition from the laboratory to something more like furniture. The Arcolette still retained a lift-up lid, but the controls were less conspicuous than the traditional calibrated knobs.

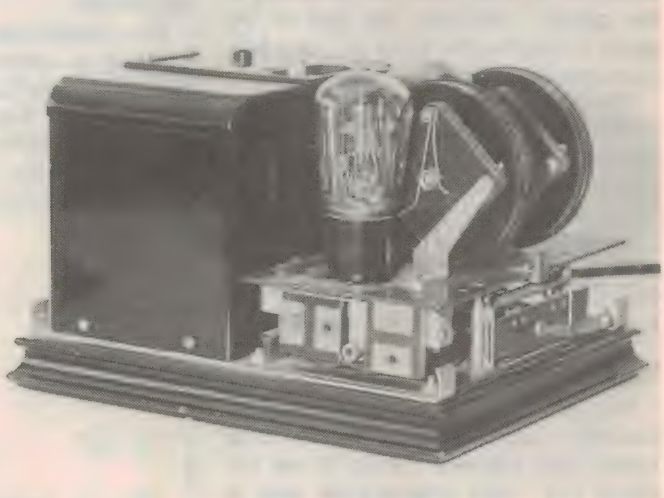
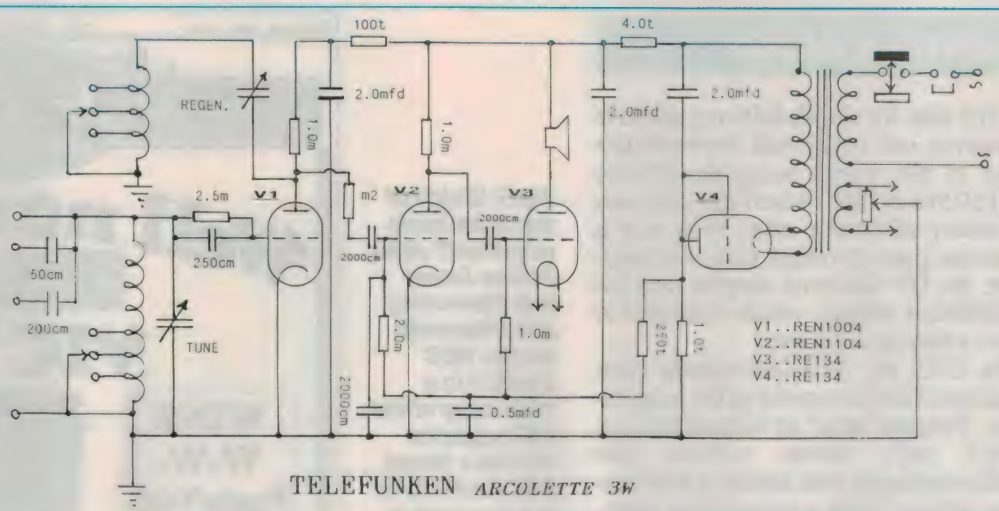


Fig.2: With the outer case removed, the solid dielectric variable capacitors attached to the sides of the thumbwheels can be seen to be very compact. The few resistors and capacitors fit under the paxolin panel.

The schematic for the Arcolette shows that its circuit is as innovative as the physical construction. Note the use of a diode-connected triode as the rectifier, and the way it provides 'back bias' for the audio stages. The value of the smaller capacitors is given in 'centimetres', where 1cm is about 0.9pF.



covers the European longwave, some marine frequencies, and the normal mediumwave bands.

Both thumbwheels have simple 0 - 10 scales on their perimeters, and drive the very compact solid dielectric variable capacitors used for tuning and reaction controls. No chances are taken with safety. The power supply is totally enclosed and a safety switch disconnects the mains if the lid to the rectifier compartment is opened.

Although the 3W is a very simple three valve regenerative receiver, the circuit is worth some study. The detector and first audio stage valves were from the first generation of indirectly heated cathode valves produced by Telefunken, the REN1004 detector having an amplification factor of about 33 while that of the general purpose REN1104 (a valve with roughly the performance of the American 227) is a modest 10. Originally a battery output valve, the RE134 directly heated triode is capable of producing an output of about a half watt and, strapped as a diode, is also a satisfactory half-wave rectifier for the 17mA or so of HT current drawn by the Arcolette circuit.

The power supply capacitors are paper dielectric, with the 2uF units assembled in a tin box. The smaller capacitors all have mica dielectric and are specified in the old 'centimetre' units. One cm corresponds to 0.9 picofarad and for the record, 1000cm is equal to 1.0 jar (900pF)!

The resistors appear to be a deposited film on a ceramic rod and spirally cut, an advanced process commonly used today. Low value resistors are rated in thousands of ohms, with the suffix 't' the equivalent of the modern 'k'.

There are three antenna terminals. For very short aerials there is a direct connection to the tuning coil, and to reduce the loading of longer aerials there is a choice of a '50cm' (45pF) or '250cm' (225pF) series capacitor. No volume control is provided, but overall gain can be adjusted to a certain extent by the setting of the reaction control C2. Surprisingly for such a modest radio, gramophone pickup terminals are provided. With the pickup connected, the RF input is disabled by being effectively short circuited.

The audio amplifier (V2) is resistance coupled, but the 1M anode load resistor is an unusually high value for the low impedance REN1104 valve. There is no output transformer, and a common bias voltage is used for both audio valves. With only very small filter capacitors and resistive filtering, HT supply hum would be excessive for a moving coil speaker system, but is satisfactory when used with a moving iron or horn speaker.

At first glance, the configuration of the power transformer wiring seems to be somewhat unconventional. What Telefunken have done is to connect the rectifier into the negative side of the supply. There is nothing wrong with this method, which was used to a certain extent in battery eliminators using half-wave rectification, but it is not practical for full wave valve rectifiers.

The 'Volksempfanger'

Compared with its more complex contemporaries, the Arcolette has a limited performance and can be regarded as a strictly local station receiver. The regeneration control is not very smooth and worse, the detector is very prone to burst into an audio howl. Non-technical users would have found the set difficult to control, and once set up would have been tempted to leave it tuned to one station.

Other manufacturers found a demand

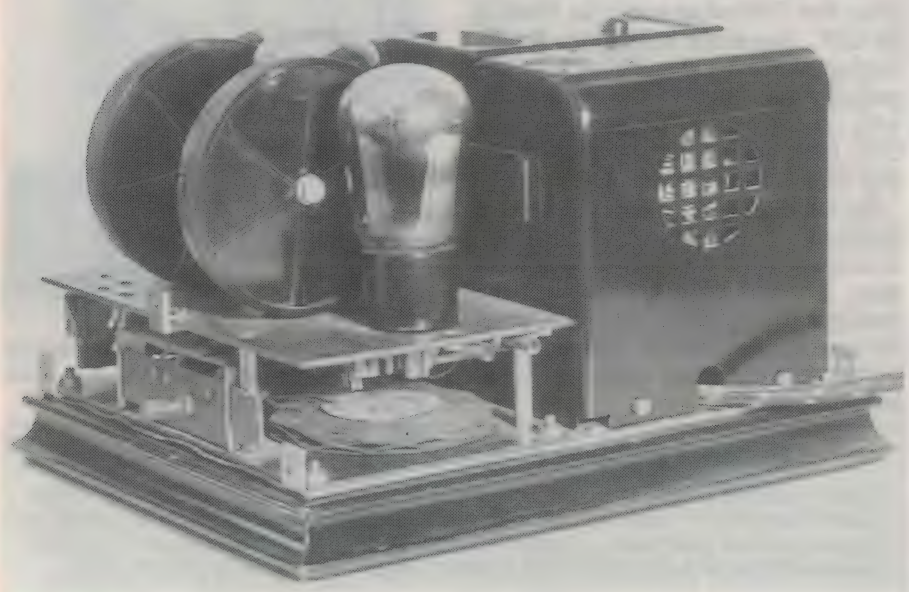


Fig.3: From this side, the flat 'spiderweb' tuning coil can be seen under the paxolin panel. The battery model is similar but without the power supply in the boxes at the rear.

at this time for simple little regenerative receivers, one of the best known in this part of the world being the Philips 2515/2516 or 'QP', which was built into a battery eliminator case! With only a detector, pentode output valve and rectifier, the QP was even simpler than the Telefunken midget, which was itself to have a famous successor.

In 1933, the Nazi Government commissioned the first model of the inexpensive 'Peoples' radio' or *Volksempfanger*. With only three valves, the Volksempfanger was strictly a local station receiver, with a regenerative detector and basic audio amplifier and with volume controlled by variable aerial coupling. It went through several developments, and by 1938 had been simplified to a rectifier and triode/pentode valve — and incidently, with a thumbwheel tuning control.

Eventually more than three million Volksempfangers were made, and served well their intended purpose of providing the German workforce with an affordable receiver having limited ability to receive foreign broadcasts. Today they are prized collectors' items.

A mystery

There is an unexplained coincidence surrounding the battery version of the Arcolette. In Britain, the General Electric Company was at the same time selling its Victor 3 model, and by comparing Figs.5 and 6 it will be seen that there is a remarkable similarity between the two.

Although I have not been able to make a side by side comparison, the similarities have been confirmed by various pictures and descriptions. Although there are some minor differences such as the paint finish and the British model having a wooden lid, the resemblances are remarkable, even to the paxolin panel and the hard rolled copper wiring.

One's first reaction would be to assume that Telefunken made the Victor 3 for GEC. But in his book *Radio Radio*, English writer Jonathan Hill states categorically that 'most of the components were specially made for the receiver by GEC itself and not just bought 'off the peg' from component manufacturers'.

On the other hand, given the state of Germany's economy in 1928, and that Telefunken itself was a major manufacturer, it seems most unlikely that the Arcolette would have been contracted out to a British firm. So what really did happen, and who made what, have yet to be explained. ❖

Fig.5: Which of the firms made which set? John Stokes found this interesting advertisement for the GEC Victor 3 in a 1928 copy of the UK magazine Wireless World. The similarity to the Arcolette is even more marked when viewed from other angles...

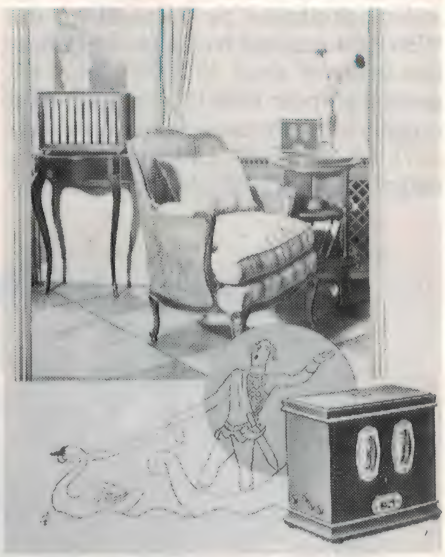


Fig.4: This illustration of the battery Arcolette was copied from the 1928 Telefunken catalog.

Collectors please note: old instruments available

Trevor Stahlfest-Moller, of the Electrical and Computer Engineering Dept. at James Cook University in Townsville, has three old test instruments that are available to anyone who will take them: a Philips PM5140 audio generator, a Marconi TF 885A/1 video oscillator, and a Boonton 160A Q meter. His phone number is (077) 81 4459.

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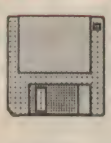

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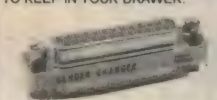

DB9P / VGA S	$6.50
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DB25P / DB9S	$5.50
DB25P / DB9P	$5.50
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DB9P / DB9P	$6.50
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1.44M 3.5" FDD **$75.00**
1.2M 5.25" FDD **$90.00**

1 YEAR WARRANTY!!
JAPANESE BRAND

HARD DRIVES

VERY RELIABLE, AND FAST
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3.5 HDD BRACKET	$9.95
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- VERY STURDY & STYLISH.
- ALL HARDWARE INCLUDED.
- COMPLETE WITH POWER SUPPLY & CABLE.

FLIP-TOP	WERE $89 ***NOW $79***
MINI-TOWER	WERE $115 ***NOW $99***
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KTX

14" SVGA
COLOUR MONITOR
.28mm DOT PITCH
1024 X 768

- STYLISH DESIGN WITH ALL CONTROLS LOCATED IN FRONT FOR EASY ACCESS.
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1 YEAR WARRANTY!!

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PROTECT YOUR APPLIANCES WITH THIS HIGH PERFORMANCE POWER FILTER. THEY AUTOMATICALLY DETECT AND REACT AGAINST DANGEROUS HIGH VOLTAGE SPIKES AND INTERFERENCE THAT CAN CAUSE BREAKDOWNS, POOR PERFORMANCE OR LONG TERM DAMAGE TO YOUR VALUABLE APPLIANCES AND EQUIPMENT. AC LINE FILTERS ENSURE A SAFE TROUBLE FREE OPERATION.

BEWARE OF CHEAP MODELS WHICH OFFERS NO LINE FILTERING.

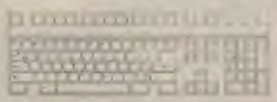
COMPARE THESE SPECS:

CLAMPING VOLTAGE 275V
CLAMPING SPEED 1~2nS
PROTECTED MODES A,N&E
ENERGY ABSORPTION 220J
FILTRATION RFI & EMI

$59.95

UNBEATABLE VALUE!!

SPILL-RESISTANT
101 KEYBOARD



NEW

- NO MORE CRYING OVER SPILT COFFEE!!
- ELECTRONICS AND LIQUIDS SUCH AS COFFEE, TEA, AND SOFT DRINKS DON'T MIX.
- IF YOU'VE EVER WORKED LATE INTO THE NIGHT, YOU KNOW THAT COFFEE SPILLS ARE A REGULAR OCCURENCE.
- PROTECT YOUR VALUABLE COMPUTER.
- 1 YEAR WARRANTY.

INCREDIBLE $39

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386SX-33	$165
386DX-40 128K	$259
486SX-33	$495
486SX-33 256K	$650
486DX-33 256K	$830
486DX2-50 256K ..	$1055
486DX-50 256K	$1125
486DX2-66 256K ..	$1295

ALL 486DX BOARDS WITH 2 X VESA LOCAL BUS SLOT.

ALL BOARDS WITH FULL 12 MONTH WARRANTY

TCM3105
MODEM CHIP

- WE JUST RECEIVED A SHIPMENT OF THESE VERY POPULAR BUT HARD TO FIND CHIPS.
- USED IN MANY MODEM KITS AND PROJECTS.
- SPEC. SHEETS CAN BE SUPPLIED WITH ORDER UPON REQUEST.

INTRODUCTORY PRICE OF $17.50

SEMICONDUCTORS

BUY IN BULK AND SAVE $$$'S!!!

	NORMAL UNIT PRICE	*SALE PRICE*
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1N4148 (PK. 100)	$0.10	**$3.00**
1N4004 (PK. 100)	$0.10	**$6.00**
1N4007 (PK. 100)	$0.20	**$7.00**
1N5404 (PK. 100)	$0.30	**$14.00**
1N5408 (PK. 100)	$0.45	**$16.00**
LED'S		
3mm RED (PK. 100)	$0.20	**$10.00**
3mm GRN (PK. 100)	$0.30	**$15.00**
3mm YLW (PK. 100)	$0.30	**$15.00**
5mm RED (PK. 100)	$0.20	**$10.00**
5mm GRN (PK. 100)	$0.25	**$18.00**
5mm YLW (PK. 100)	$0.30	**$18.00**
TRANSISTORS		
BC547/8/9 (PK. 100)	$0.15	**$7.00**
BC557/8/9 (PK. 100)	$0.15	**$7.00**
IC'S		
555 (PK. 50)	$0.65	**$20.00**
741 (PK. 50)	$0.60	**$18.00**

READER INFO NO. 22

50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Below we feature some items from past issues.

August 1943

Mechanical brain: A mechanical brain, which takes all the guesswork out of aerial gunnery, is one of the reasons for the high score of enemy fighters shot down by Flying Fortresses.

Known as the Sperry automatic computing sight, the mechanism combines the functions of an optical sighting unit and a computing machine. By the manipulation of wheels and levers, gunners immediately calculate the relatives rates of speed, allowances for wind deflection, and for deflection due to gravity pull.

Flying leviathan: The world's biggest airliner, weighing 130 tons and needing a three-mile runway is to be built in England. It will require a five-mile clearance for climbing and approaching.

The designer predicts a two-way service between Britain and Australia, with only four stops for fuel. It will carry a crew of 15, besides 150 passengers by day and 75 by night, and its engines will ensure a cruising speed of 250-300mph.

August 1968

Enhanced photos: A group of Boeing engineers is turning out improved photographs of the moon taken by the five Boeing-built Lunar Orbiters. Called 'photo enhancement', its purpose is to squeeze more information out of the Orbiter photos for study by space scientists .

All the photographic information transmitted to Earth during five lunar missions is stored on video tape. To uncover hidden data on the tapes involves several passes of each section of tape. A video processor examines details in selected portions of the video signal. Data within the signal may be expanded to give better resolution and contrast, and therefore a sharper photograph. The signal levels are adjusted to bring out more detail in lighter and improve resolution in darker areas.

Sydney ILS: The new Instrument Landing System (ILS) at Sydney's Kingsford Smith Airport has been successfully tested and will be brought into operation progressively as the extended north-south runway comes into service.

When in full operation, it will be possible, in theory, for a pilot to bring his aircraft right down on the runway in zero visibility. When used with an airborne computer, an automatic pilot can make a 'no hands' landing. In practice, neither of these two possibilities will happen, but the new equipment will make aircraft landing in conditions of poor visibility and bad weather much safer.

Computerised telephones: Australian manufacturers are preparing tenders for the supply of electronic equipment for use in Australia's first computer-controlled telephone exchange.

The exchange will be sited in Pitt Street, Sydney. It will be designed to carry the greatly increased trunk line traffic expected in the next 10 years. A Post Office spokesman said he knew of only one computer-controlled exchange already in operation, in Belgium. ❖

EA CROSSWORD

ACROSS

1. Loudness. (6)
4. Discoverer of reflective ionised layer. (8)
10. Condition associated with magnetic flux in a coil. (7)
11. Physicist who first found the electron. (7)
12. Organs with light-sensitive rods and cones. (4)
13. Place component on circuit board. (5)
14. Said of energised conductor. (5)
17. Name of river in hydro-electric scheme. (5)
18. Operating a keyboard. (6)
21. Dissertation in tertiary studies. (6)
22. Vital components in tape machines. (5)
26. Trigonometrical ratio. (4)
27. Visual discoverer of the planet Neptune. (5)
28. A bit per second. (4)
31. Return from space to our atmosphere. (2-5)
32. EA reviewer of excellence, Louis ——. (7)
33. Manufacturer of speakers. (8)
34. Popular brand of CB radio. (6)

SOLUTION FOR JULY 1993

H	E	A	T	S	I	N	K		C	O	B	A	L	T
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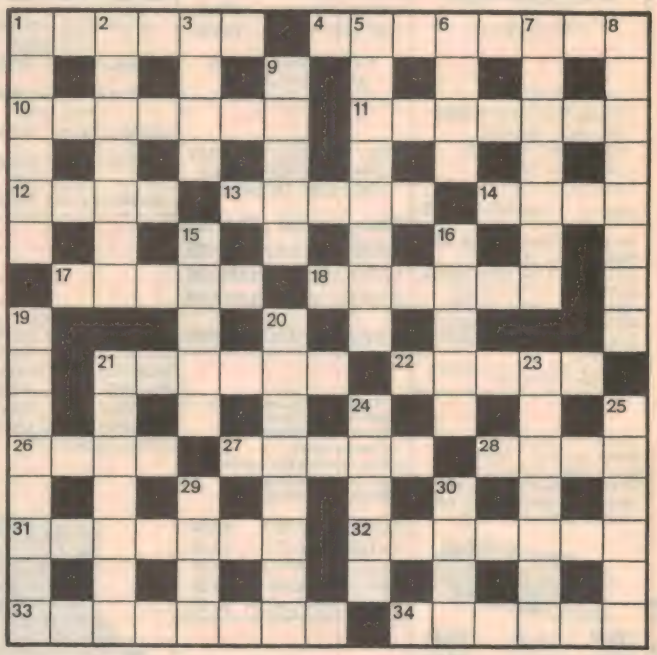
I		H		H		E		A		I		I		C
T	H	E	O	R	Y		P	L	U	G	P	A	C	K

DOWN

1. Parts of vintage radios. (6)
2. Lighting device. (7)
3. Security channel with liquid resistance! (4)
5. Granted right to an inventor. (8)
6. RDFs use a —— aerial. (4)
7. Determining quality, accuracy, etc. (7)
8. One of a significant group of elements. (3-5)
9. Name of an artificial satellite. (5)
15. Traverse through an angle. (5)
16. These depict a field. (5)
19. Unit of length equal to 10^{-10}m. (8)
20. Said of hearing with both ears. (8)
21. Mathematical line on a curve. (7)
23. Initiated a telephone call. (7)
24. Schematic outline, the —— diagram. (5)
25. Famous American invetor. (6)
29. Object used by spacecraft in guidance. (4)
30. Syllable coupled with frame to give a computer type. (4)



EA with ETI marketplace

ADVERTISING RATES FOR THIS PAGE

SMALL ADS: The minimum acceptable size of 2 centimetres x one column costs only $50. Other sizes up to a maximum of 10 centimetres are rated at $30 a centimetre. **CLASSIFIEDS:** $4 for 40 letters. Just count the letters divide by 40 and multiply by $4, ROUND UP TO THE NEAREST WHOLE NUMBER. **CLOSING DATE:** Ads may be accepted up to the tenth of the month two months prior to issue date. **PAYMENT:** Cheque or money order only. Please enclose payment with your advertisement. Address your letter to: **THE ADVERTISING PRODUCTION MANAGER, ELECTRONICS AUSTRALIA, P.O. BOX 199, ALEXANDRIA NSW 2015**

FOR SALE

PAY T.V. AND SATELLITE SCRAMBLING NEWS MONTHLY: Always with the latest on descrambling technics and address where to buy the latest descramblers. 12 issues only $40 posted. John Papp Box. 37885 Winnellie, 0821, N.T.

VIDEO HEADS "HQ" JAPANESE HIGH QUALITY – HIGH OUTPUT:

AKAI	PU3332G-10	$32
AKAI	PU333L	$29
NATIONAL	VEH0103/121	$29
NATIONAL	VEH0177	$67
NATIONAL	VEH0201	$81
NATIONAL	VEH0218	$32
NATIONAL	VEH0265	$78
NATIONAL	VEH0267	$67
NATIONAL	VEH0286	$32
NATIONAL	VEH0287	$55
NATIONAL	VEH0343	$61
NATIONAL	VEH0416	$51
TOSHIBA	70321806	$41
HITACHI	5458104/282	$33
SHARP	DDRMU0002HE17	$33
MITSUBISHI	928B32207	$80
MITSUBISHI	928B408050	$95

See last months marketplace for other types ph/fax (09) 349 9413

MULTIMETER Benchtop digital HP 34401A 6.5 digit Brand new Never Used $1,000 Ph: (079) 42 1950

LCR METER Benchtop digital HP 4263A Brand new Never Used $4,000 Ph: (079) 42 1950

AMIDON FERROMAGNETIC CORES: For all RF applications. Send business size SASE for data/price to RJ&US Imports, Box 431 Kiama NSW 2533. Agencies at Geoff Wood Electronics, Sydney: Webb Electronics, Albury: Assoc. TV Service, Hobart: Truscott Electronics, Melbourne.

PLANS FOR 1KW LOW-REVVING BRUSHLESS GENERATOR: - "The Homebuilt Dynamo" details, call Al Forbes, 0011-649-818-8967

WEATHER FAX PROGRAMS: For IBM XT/AT's *** "RADFAX2" $35, is a high resolution, shortwave weather fax, morse & RTTY receiving program. Suitable for CGA, EGA, VGA & Hercules cards (state which). Needs SSBhf radio & RADFAX decoder. *** "SATFAX" $45, is a NOAA, Meteor & GMS weather satellite picture receiving program. Needs EGA or VGA, & "WEATHER FAX" PC card. *** "MAXISAT" $75 is similar to SATFAX but needs 2mb of expanded memory (EMS 3.6 or 4.0) & 1024 x 768 SVGA card. All programs are on 5.25" or 3.5" disks (state which) + documentation, add $3 postage. ONLY from M. Delahunty, 42 Villiers St, New Farm 4005, Qld. Ph (07) 358 2785.

KITS ASSEMBLED OR REPAIRED: Low rates. Contact Autronics on (08) 294 8591

EPROM: Reader software is included with my interface to control the outside world from a PC parallel port. 32 bits in. 32 bits out. Units can be cascaded. short form kit $35. Relay PCB to suit. $15, or send $2 for my 3.5" demo disk. Don McKenzie 29 Ellesmere Cres Tullamarine 3043.

ROMLOADER: Eprom Emulator (EA Jan/Feb 92) upgrade to handle 27128, 27256 EPROMs. Includes memory edit facility. 8051 Proto-Boards (EA Feb 93) also available. Send S.A.E. for details. Tantau Australia P.O. Box 1232 Lane Cove 2066 A.H. (02) 878 4715

GLOBAL ELECTRONIC SERVICES Kits; Consultancy; Sales and Design. Please Write or Fax requirement to : Mr Lucas P.O.Box 755 Saint Helier Jersey JE4 8ZZ Channel Islands (UK) FAX : (0 534) -80570

PRICE MADNESS Electrolytic Capacitor Sprague U.S.A 99000uf 75VAC + 95°c. Height : 215mm Diameter : 75mm Price : 3 for $60.00. Please allow for postage & packing. Jim Rogers 11 Montreal Ave, Killara N.S.W 2071.Ph: (02) 418 1265 Fax: (02) 498 4466

A 4MB SIMM can now be used in my printer buffer kit, and my PC Printer Port driven Z80 Micro Development board has a Basic Interpreter. Short Form Kit prices include Postage.Buffer $52, Z80 Dev. $76, or send $2 for my 3.5" promo disk. Don Mckenzie 29 Ellesmere Cres Tullamarine 3043.

UNUSUAL BOOKS: Electronic Devices, Fireworks, Locksmithing, Radar Invisibility, Surveillance, Self-Protection, Unusual Chemistry and More. For a complete catalogue, send 95 cents in stamps to: VECTOR PRESS, Dept E, PO Box 434 Brighton SA 5048.

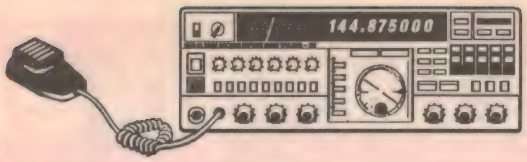
FAX DECODER: For satellite and HF signals. Designed for JV fax program offers superb picture resolution and zoom capability PCB $29, kit $89, wide-band VHF APT satellite receiver PCB $19, kit $78. include $5 postage. Send cheque to Technocom 187 McLarty Road Halls Mead Mandurah 6210 (09) 581 4297.

SELL very old radios, books, manuals, rare valves, transformers, charger (07) 356 6052

RADIO AND TV VALVES: Din plugs and sockets. Coils and transformers, speakers and microphones, all new, price list, ph/fax (07) 208 9034

continued next page

Amateur Radio News



Summerland ARC's annual hamfest

Summerland Amateur Radio Club's publicity officer Graeme Virtue VK2GJ sent in details of his club's upcoming hamfest, hoping that we could fit them into the July issue. That issue had already gone to the printers when they arrived, but as this issue should be published a few days before the hamfest, it shouldn't be too late.

The hamfest is planned for Sunday August 1st, and the venue is the SARC's clubrooms at Richmond Hill, via Lismore on the northern coast of NSW. The starting time is 9.30am.

Attractions planned include disposal tables, 'bring and buy' stalls, a packet radio demonstration, operating HF and VHF stations, trade displays and if possible a radio foxhunt. Refreshments will be available, and all amateurs and other interested people are very welcome to attend.

More information is available from Peter VK2FSD on (066) 25 2334, Ric VK2RIC on (066) 89 5137, Graeme VK2GJ on (066) 85 1336, or on packet radio VK2EA-2, VK2EJV-2 or VK2YDN-1; all via VK2RPL-2, 668900.

Type approval 'not required'

Amateur equipment will be exempt from type approval under the new standards and compliance framework of the Radiocommunications Act 1992, according to advice received by the WIA from Roger Smith, First Assistant Secretary of DOTC's Radiocommunication Division.

Mr Smith conveyed the good news in a letter which followed up on a meeting between him and David Wardlaw VK3ADW in February, and a confirming letter from WIA General Manager and Secretary, Bill Roper VK3ARZ.

In his letter, Mr Smith said 'This exclusion has been made because of the experimental nature of the activity pursued by radio amateurs. It is also consistent with the approach taken in other countries, such as Europe.'

'We will request that Standards Australia make generic standards covering all radiocommunications equipment. These generic standards will be based on international standards (where they exist).'

'Amateur radio equipment would be required to conform to the requirements of mandatory generic standards.'

'The WIA has been invited to participate in the relevant Standards Australia committee to ensure that it is able to represent the needs of Amateur users.'

Australian amateur statistics

As at 31 March, there were 18,222 amateur licences issued in Australia, according to statistics supplied to the WIA by the DOTC. Of this number, there were 10,634 unrestricted stations, 2633 Novices, 1538 Combined licensees, 3390 Limited and 27 beacons.

Buried in the statistics, there are 334 amateur repeater licences — which the WIA says 'compares well with 427 CB radio service repeater licences'. ❖

EA with ETI marketplace

WANTED

WANTED: SITUATION VACANT Technician Perth W.A Capable of servicing T.V's & video's plus installing and servicing satellite recievors & decoders. At least 5yrs experience needed, also City and Guilds or equivalent certificate. Salary $418 per week. Apply in writting to Don Mcleod 16 Bradbury Road, Armadale, W.A

EARLY VALVE HI-FI'S: amplifiers, speakers, turntables, valves, wireless etc. Cash paid. (02) 488 8184

WANTED: Faulty INTEL486CPU: 486SX-25, SX33, DX33, DX2-50, DX 50, DX2-66, $10-$20 each, P.O. Box 870, Cabramatta 2166 Ph (02) 724 7794 (AH)

WANTED: A complete set of "Australian Official Radio Service Mannuals " 1930 - 1960. C.Rogers P.O Box 416 WODONGA VIC 3689 Ph: (060) 245 223

COPY OF FLEX 9.0: For 6809 based computer and to get in touch with any other users.Reply to A.Chivers, 285 Carrington St New Plymouth, N.Z.

L.E.D WRIST WATCH: Phone (069) 771 977

ELECTRONICS AUSTRALIA: Jan 1987 Phone (02) 604 7291 (AH)

Electronics Australia's

Professional Electronics

S · U · P · P · L · E · M · E · N · T

REVIEW OF PROTEL'S NEW 'SCHEMATIC FOR WINDOWS' PACKAGE

COMPONENT DATA NOW AVAILABLE ON CD-ROM — FOR PROFESSIONAL USERS

WE TEST THE 'TONER TRANSFER' PCB SYSTEM

TELECOM MARITIME SERVICES DEMONSTRATES SATCOM-M GLOBAL SATELLITE COMMUNICATIONS USING A PORTABLE BRIEFCASE-SIZED PHONE/FAX/DATA TERMINAL

NEWS HIGHLIGHTS

NEW VIDEO, AUDIO DISTRIBUTOR

Gil Carver and Tom van der Meyden, formerly of Arista, have formed a new firm specialising in audio, video and computer accessories. Their new Avico Electronics is located at Unit 4, 163 Prospect Highway (PO Box 720), Seven Hills 2147; phone number (02) 624 7977, fax (02) 624 7143. Administration is being looked after by Leanne Brealey and Margaret Easton.

Avico has an initial stock range covering over 400 products, listed in its first 32-page catalog. All products are competitively priced, have a 12-month warranty and are backed by courteous technical support.

The Avico warehouse will be open for trading between 8.30am and 5.30pm, Monday to Friday, and pickups are available. The company is also offering overnight delivery to most metropolitan areas.

CREDIT-CARD SIZED WIRELESS MODEMS

Motorola's Paging and Wireless Data Group (PWDG) has announced and demonstrated the technology for a new family of intelligent wireless modems for pocket-sized, handheld and portable computing/communicating devices.

The new family of modems are credit-card sized and use the PCMCIA format, designed to provide a standardised open system for adding memory and I/O capabilities to computers.

Firms which have expressed support for the development of worldwide common connectivity standards using the PCMCIA wireless system include Apple Computer, Ardis, Bellsouth, Compaq Computer, Dell Computer, General Magic Inc., GTE, Hewlett-Packard, IBM PC Company, Microsoft, Novell, Sony and Toshiba.

Motorola's PWDG has also formed an alliance with many of the above firms, plus AT&T, Matsushita and Philips, to develop a battery operated wireless two-way 'personal intelligent communicator' device for business users and ultimately the mass market.

FIRST MOVIES FOR CD-I

In a development claimed to usher in a new era of home entertainment, Paramount Pictures and Philips Interactive Media have announced a multi-year agreement to put theatrical length movies on the Philips Compact Disc-Interactive (CD-I) system. Paramount is the first major studio to provide movies for the new full screen, full motion digital video technology developed by Philips exclusively for CD-I.

The agreement will cover the distribution of movie titles in the US and Canada. The movies will be released on CD-I at the same time as Paramount's video cassette releases.

Paramount and PIMA also have agreed to explore the development of interactive CD-I titles, some of which may be based on future Paramount movies.

EXPERTECH SYSTEM RUNS ADELAIDE CABS

The installation of an Australian developed Expertech Advantage computer call-taking and despatch system at Adelaide Independent Taxis is said to mark a major milestone for the group.

The system was selected to allow the group to cope with its current growth (from 28 to over 200 cars in one year), but equally important, to ensure that the best features of available technology were used to give drivers and staff the benefits of computer operation whilst retaining familiar and proven operating methods.

The inhouse system is based on a Novell Network with dual 486DX-33 File servers with 1.3GB of disk storage and nine 386DX-40 workstations, giving it more than enough resources to process the anticipated 200,000 bookings per month workload.

The Expertech MDT-301 Mobile Data Terminals fitted to all cars in the fleet have been designed to allow drivers to

GROUP TO STUDY VIDEO COMMS

A project group has been set up to investigate video-based telecommunications services for ATM (asynchronous transfer mode) networks.

Support for the collaborative project has been provided by a Communications Technology Generic Grant of $1.3 million by the Industry Research and Development Board of the Department of Industry, Technology and Regional Development.

The project group comprises staff from Siemens Ltd, Monash University, Telecom Australia Research Laboratories, and the Australian Computing and Communications Institute (ACCI), all based in Victoria.

The goal of the Video Based Telecommunications Services (VBTS) Project is to define, develop and demonstrate advanced user services to be available on the B-ISDN (broadband ISDN) public switched network.

The Universal Video Codec Project — successfully completed recently by substantially the same research team — provided the fundamental technology to deliver video services over ATM based broadband networks.

The VBTS Project aims to make the next step by integrating the video component with other information forms in an audio-visual or multimedia environment and then identifying the real requirements of such services, which could include multimedia (voice plus text plus image), mail or person-to-person video telephony.

receive their booking details quickly and to display the information in a format which is easy to read. The new technology employed in the Mobile Data Terminals will also allow the fleet to add vehicle location systems or move to full driver-controlled despatch at a future date, if required, and at minimal cost.

CD-ROMS HOLD COMPONENT DATA

Hinton Information Services is now offering its comprehensive CD-ROM based IC/Discrete Parameter Database at a subscription price of $4500, including 52 CD-ROM image disks containing scanned manufacturer datasheets. Produced by the US-based Information Handling Services Group and billed as the 'world's largest electronic component database', the system is designed to replace the more traditional Microfiche methods of component information retrieval.

Also included with IC/Discrete on CD-ROM is its own sophisticated searching and data management software, which allows the user to find components through 11 different search criteria such as part number, device characteristics, manufacturer, and so on. The device's matching datasheet can then be loaded from the appropriate image CD-ROM, and viewed, printed (on an HP-compatible laser printer) or downloaded to the computer's hard disk (as a bitmapped image) for CAD or publishing purposes.

Along with more than 1,500,000 devices and their parameters on the main index CD-ROM, the IC/Discrete database system also offers information on alternative devices, discontinued lines, and the Australian and overseas distributors for each manufacturer.

The system is compatible with most of the popular local area networks (LANs), and while primarily intended for low-cost MS-DOS based machines, it is also available in a form to suit a range of UNIX workstations.

For further information write to Hinton Information Services at Locked Bag 7, Eastwood, NSW 2122; phone (02) 804 6022, fax (02) 804 7434.

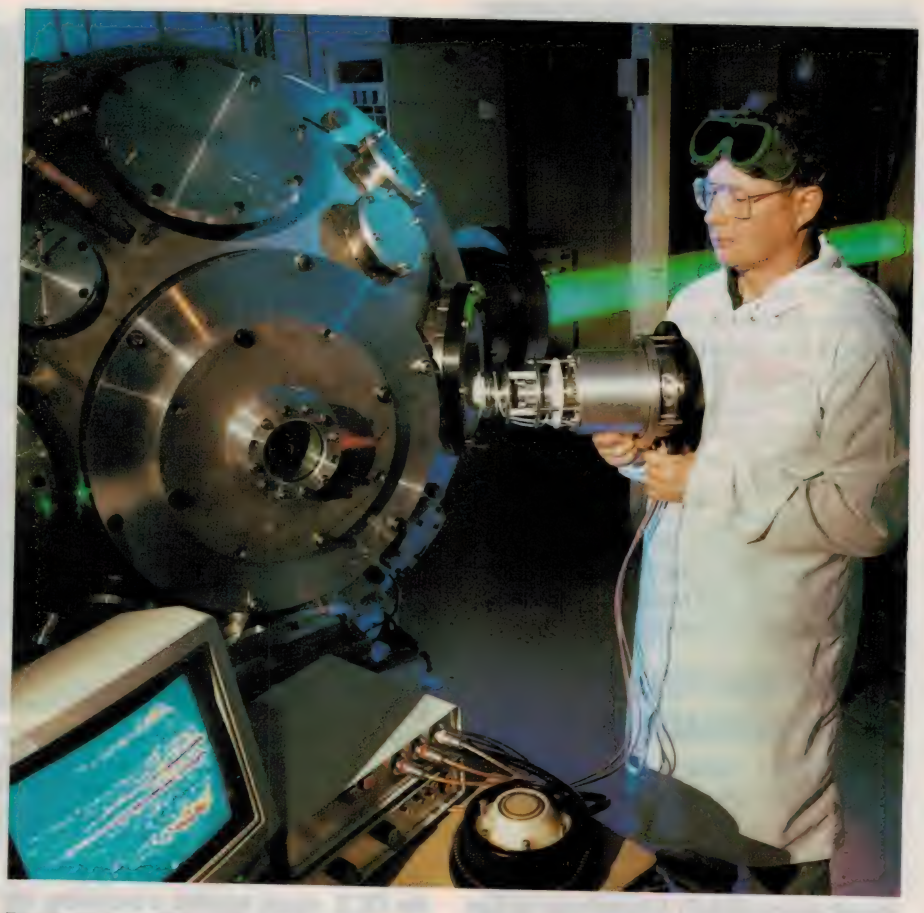
HST REPAIR MISSION EXTENDED

The December flight of NASA's Endeavour Space Shuttle mission STS-61, to service the Hubble Space Telescope (HST), has been scheduled as an 11 day mission designed to accommodate a record five spacewalks with the capability for an additional two, if needed.

The decision to schedule five extra-vehicular activities, or EVAs, was reached following extensive evaluations of underwater training, manoeuvre times required using the Shuttle's robot arm, based on software simulations and actual EVA tasks on previous missions.

"Basically what we've done by going to five EVAs rather than three is to repackage our margin so that we have the capability to respond to the dynamics, or unknowns, of spacewalks," Mission Director Randy Brinkley said. "It improves the probabilities for mission success while providing added flexibility and adaptability for reacting to real-time situations."

Designed to be serviced by a Space Shuttle crew, Hubble was built with grapple fixtures and handholds to assist in the capture and repair procedures. The telescope was launched aboard Discovery in April 1990. At that time the NASA mixed fleet manifest showed the first revisit mission to HST in 1993, to change over science instruments and make any repairs that may have become necessary.



Dr Anthony Dymocke-Bradshaw, one of the founders of British company Kentech, is shown here with his firm's X-ray 'streak' camera which was built for the Rutherford Appleton Laboratory near Oxford. Instead of using standard photography, the camera converts an X-ray image into an electronic one and 'smears' it across a screen to provide detailed information on extremely fast changing objects. The camera is being used to detect the X-ray signal given off by a plasma raised to several million degrees Celsius. in laser fusion research.

FIRST PORTABLE SATELLITE PHONE

The first portable, briefcase mobile satellite voice communications terminal, by Japanese manufacturer NEC, has been approved to operate with the Inmarsat-M system.

Weighing only 13kg, the Hand Carry Terminal model D7346B is the smallest, lightest satellite telephone terminal ever produced with a worldwide communications capability. Batteries make it possible to communicate in virtually any open-air location, completely independent of mains electricity or established communications infrastructures.

The terminal, which retails for approximately US$25,000, will also have a facsimile capability and a PC data communications function before the end of the year.

NEWS HIGHLIGHTS

The NEC briefcase terminal joins the maritime Inmarsat-M ship earth station (model MARISTAR-M9821) from American manufacturer Scientific-Atlanta, which was approved in March and is already in operation on a number of yachts and cruise ships. Further Inmarsat approved mobile earth station models will be available in the market place over the next few months, with 20 manufacturers in Europe, North America and Asia currently developing products.

Inmarsat-M service is expected to become global in August, when the Indian Ocean will be covered as well as the Atlantic and Pacific. Inmarsat-M calls cost approximately US$5.50 per minute. The system provides all digital telephony and 2.4kbit/sec data and facsimile services for land mobile and maritime applications.

'My display's bigger than your display!' Siemens is now offering this large-area display for control rooms in power stations and process plants. It's seen here showing the same display as the desktop CRT monitor. Siemens has also developed a new process control system called Teleperm XP.

USA TO USE PHILIPS GHOST CANCELLING

The USA's Federal Communications Commission has approved use of the Philips ghost cancelling signal by TV broadcasters, effective June 30.

At the recent National Association of Broadcasters (NAB) Conference in Las Vegas, Philips Research Laboratories demonstrated the world's first prototype TV receivers with built-in ghost cancellation circuitry.

The demonstration consisted of Live Ghost Cancelling Reference (GCR) signals beamed to the convention centre by five local TV stations. At the convention centre delegates compared heavily ghosted pictures with specially prepared large screen TVs, incorporating Philips ghost cancellation technology, on which there was not the slightest hint of a ghost.

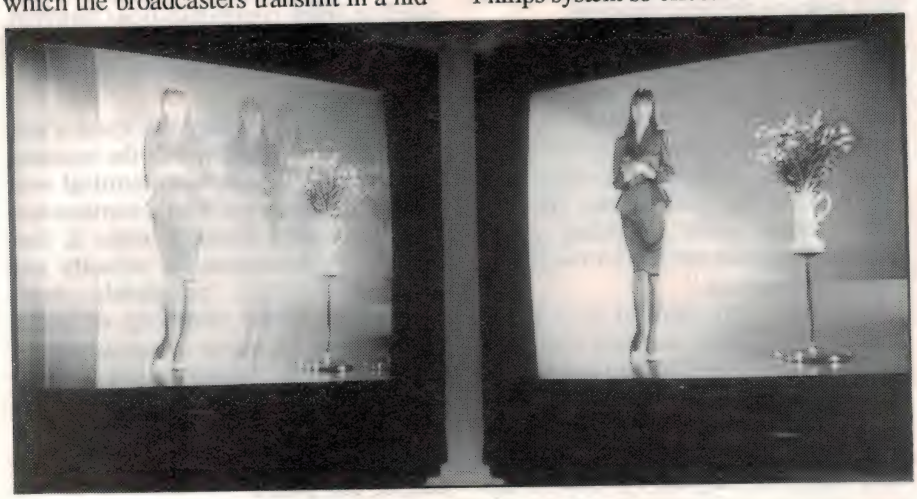
At the heart of the system is a special Ghost Cancellation Reference signal which the broadcasters transmit in a hidden portion of the TV field. By the time the GCR signal reaches a receiving antenna, it has undergone the same ghost distortions as the television picture.

The received analog signal is then changed into digital form using an inexpensive eight bit converter. Once the signal is in digital form, it can be easily manipulated.

The signal is then compared to the original GCR signal. Based upon this analysis, settings are made for a ghost cancelling filter. The filtered signal, with ghosts removed, is converted back to analog for normal viewing. This whole process is done electronically and the processing speed is what makes the Philips system so effective.

The ghost cancelling filter chip is produced by Philips, as are the mathematical algorithms and processing software that controls the system. This system has out-performed all others in trials to win the 'ghostbuster' title, and has now been adopted as the NTSC standard.

Helen Freeman, Philips TV and video product marketing manager in Australia, says we can expect the 'ghostbusting' option to be available in TV sets from 1995.



OPTUS USING AUST LOGGERS

The repeater stations in the new fibre optic network being installed by Fujitsu for Optus are being monitored by Datataker data loggers, designed and built in Australia by Data Electronics.

Environmental conditions in the remote unmanned repeater stations are critical for the proper operation of equipment responsible for maintaining the signal strength within the telecommunications network. Repeater stations are spaced at approximately 50km intervals.

To maintain suitable environment conditions, each station is equipped with an air conditioning system, and an autonomous power supply. The performance of the air conditioning system and the status of the back up power systems is constantly monitored by Datataker data logging systems, and regularly reported by the loggers to base stations. Any departures from set environmental

specifications or malfunctions in the power systems are immediately reported.

The monitoring system for the remote repeaters is based on standard Datataker loggers, running special application software developed especially for the application by Data Electronics.

DOTAC TO TEST DAB

Philips Consumer Electronics is supplying the Australian Department of Transport & Communications (DOTAC) with a digital audio broadcast (DAB) development system. The Philips system is based on the European Eureka 147 DAB system, now in the final stages of development. Comprising an encoder and decoder, the Philips equipment will be used by DOTAC's Communication Laboratory for preliminary investigations into this new digital broadcast technology.

DAB represents the next generation sound broadcast technology. It promises to deliver CD quality sound to home, portable or vehicle receivers, with far fewer transmission impairments than those suffered by the current AM and FM broadcast systems.

Possible transmission delivery methods for DAB include terrestrial (from ground based masts), satellite or hybrid terrestrial/satellite based schemes).

In Europe and North America, broadcasters and regulators are showing increasing interest in the development of a new audio broadcasting service with improved sound quality for listeners. The Eureka system is claimed to lead current world development in this area. It allows up to five CD-quality sound services in a 1.5MHz frequency block, with the flexibility to 'trade-off' sound quality for increased program capacity.

NEWS BRIEFS

- ***IRH Components***, a division of Bell-IRH Industries, has been appointed as the Australian and New Zealand representative/distributor for TEMIC, the semiconductor division of Daimler Benz. TEMIC is a combination of three semiconductor principals: Siliconix, Telefunken Electronic and Matra MHS.
- Colorado-based US manufacturer of analog signal processing components, Comlinear, has appointed ***Zatek Components*** as its Australian representative.
- Sydney-based ***Obiat*** has been appointed as Australian distributor for the range of test and measuring instruments from AEMC of Boston, USA. Included is a full range of AC and DC current probes.
- ***TDK (Aust.)*** has appointed Mr Dennis O'Sullivan as its NSW Sales Manager and Mr Martin Moelle as Assistant to the General Manager.The company has also recently moved to larger premises at 22 Lambs Road, Artarmon (Postal address, PO Box 55, Artarmon 2064). Its phone and fax numbers remain the same — (02) 437 5100 and 439 7151, respectively.
- ***Independent Information Technology Training*** is offering a hands-on course on 'Troubleshooting & Upgrading PCs — Advanced level'. The course will be held twice this year in Sydney at IIT Training from 18-20th August and 24-26th November; and twice in Melbourne at the Sheraton Hotel from 28-30th August and 17-19th November. For more information contact IIT Training, PO Box R817, Royal Exchange 2000; phone (02) 252 2844, fax 247 1048.
- Banksia Information Technology of Lane Cove, Sydney has officially shortened its name to ***Banksia Technology***. However, it still expects to be called just 'Banksia'!
- AVX/Kyocera has appointed ***VSI Promark Electronics*** as a fully authorised distributor for Australia and New Zealand. ❖

TELECOM PREVIEWS SATCOM-M COMMS

In a nationwide tour, Telecom Australia has given preview demonstrations to show its ability to provide cost effective, mobile satellite communications to customers living and working in remote areas, via Inmarsat's Satcom-M system.

A lightweight briefcase-sized terminal, the Satcom-M terminal is a compact satellite communications device that allows people to send and receive voice, data and fax from anywhere in the world.

"Satcom-M's introduction is a milestone as it offers global travellers and remote users ready access to low cost and very portable satellite communications anywhere in the world," said Mr Warren Grace, managing director of Telecom's Enterprises Business.

THORN WINS AS3902 CERTIFICATION

Quality certification to AS3902 has been achieved at Thorn Lighting's Melbourne plant, with third party approval being granted by Standards Australia's Quality Assurance Services through their Quality Endorsed Company Scheme.

The significant achievement in meeting the stringent requirements of Australian Standard AS3902 (Quality systems for Production and Installation) was driven by a commitment to quality from all management and staff. The certification was realised after an extensive audit of all activities in every facet of the organisation.

AS3902 is the exact equivalent of the International Standard ISO9002, and allows worldwide recognition of the methods used to provide quality products and services from the Thorn organisation.

TOSHIBA'S CHINA PLANT OPERATING

Toshiba Corporation's subsidiary in Dalian, Liaoning Province, China, started production this April. The company is manufacturing small industrial motors, deflection yokes for colour televisions, printed circuit board (PCB) units for televisions and VCRs, and delay lines.

Toshiba Dalian is capitalised at 7900 million yen, 7500 million of which is held by Toshiba, 300 million by Mitsui and 100 million by Toshiba affiliate Showa Electric Wire & Cable. The company has built 50,000m^2 of production and office facilities on a 126,000m^2 site.

The Dalian plant has an annual production capacity of approx. 400,000 motors, 1.5 million deflection yokes, 1.6 million PCB units and one million delay lines. ❖

Toner transfer system for making PCBs

The Queensland firm Palmtech is offering an alternative method to using a photographic negative for making printed circuit boards (PCBs). Instead, you take an image produced on either a photocopier or laser printer, and use heat from a clothes iron to transfer the toner image from the paper to the copper surface.

by PETER MURTAGH

The method that we use here at *EA* to make our PCBs involves making a photographic negative of the PCB pattern (as given in all our construction projects), laying it on the surface of a piece of Riston-coated PCB material in a darkroom, and then exposing it to UV light. The copper immediately under the tracks — the only area exposed to the UV — is 'fixed' with a chemical developer, which then allows the excess copper to be etched away.

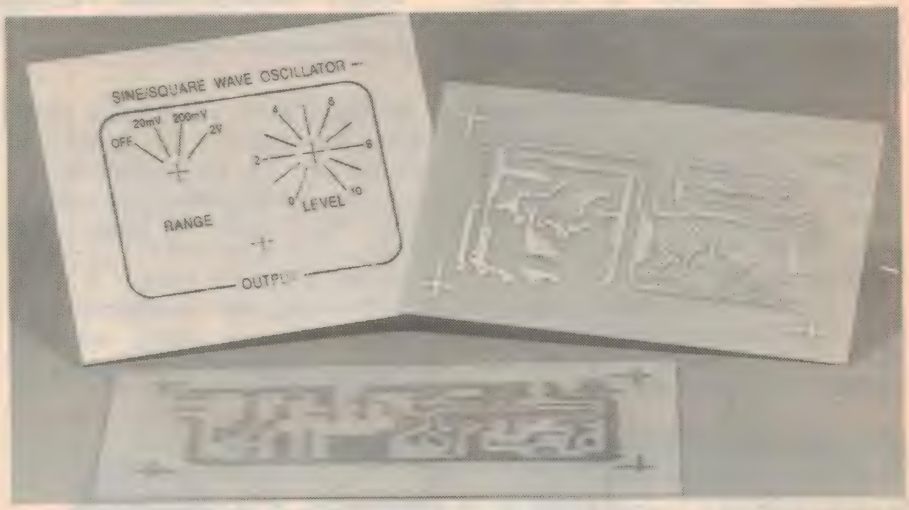
This photo-etching system is widely used, so any method which could eliminate the necessity to make a photographic negative, then use UV exposure followed by a chemical developer, would obviously have great appeal. This is precisely the attraction of the Toner Transfer System (TTS).

The idea behind TTS is that laser printers and photocopiers heat their toner image so that it melts and adheres to the paper surface — TTS simply re-heats the toner so that it can be transferred again, this time to the copper surface of the PCB.

However, after this is done, the toner image is fused to *both* the original and new surfaces. How to separate them? This problem is solved by producing the image on a water-soluble coating on the surface of the TTS paper. This means that, when the board and paper are immersed in water, the soluble layer separates from the original substrate (the paper), leaving the toner pattern adhering only to the PCB.

Iron an image!

To actually make the transfer, the method recommended by Palmtech — who supply the TTS paper — is to use an ordinary domestic iron as the heat source. You place the PCB (copper side down) on top of the paper (toner image up), and iron the back of the board for several minutes, until the toner has completely melted. This setup might seem upside down — but it works! (See the later section on 'Toner transfer' for more details.)



We made two PCBs with images from a TI microLaser (the lower board) and a Sharp SF-8870 photocopier (top right). Note the small break in the track of the second board, near the EA symbol — the image should have been treated with Dalo pen before etching. The photo also shows the result of a toner transfer front panel, produced on a piece of 2mm-thick aluminium.

Fortunately, once the toner has set (after immersion in water to remove the TTS paper, and drying), the pattern is etch-resistant. Hence, the excess copper on the PCB can be removed in the normal fashion. Then, once the board is dry, the toner outline can be scrubbed off.

The only catch to using TTS — apart from mastering the ins and outs of actually doing it — is to obtain a suitable starting image. If you look at the component overlay diagram and the PCB pattern for any project in *EA*, you will notice that the PCB pattern is a flipped version of the track layout. The reason for this is that the overlay views the pattern from the *front* of the board (the component side), whereas the PCB pattern is a view from the *back*. We provide our readers with a reversed image — the orientation needed for a direct transfer to the copper side of the board.

From the description above of how the toner transfer system works, it should be obvious that the actual transfer process itself causes an image reversal — and this is one reversal too many! Hence, the starting point for TTS has to be a normal track pattern, not the flipped one usually published. So, if you are starting the process with a published PCB pattern, to counteract this extra reversal, you must first photocopy the published pattern on to a piece of transparency film, which can then be turned upside down to copy the correct image on to the TTS paper. **Warning: Make certain that your transparency material is suitable for use in your photocopier, otherwise it might melt — with costly consequences!**

Of course, if you produce the PCB pattern from your own CAD package, then there's no need to make a transparency.

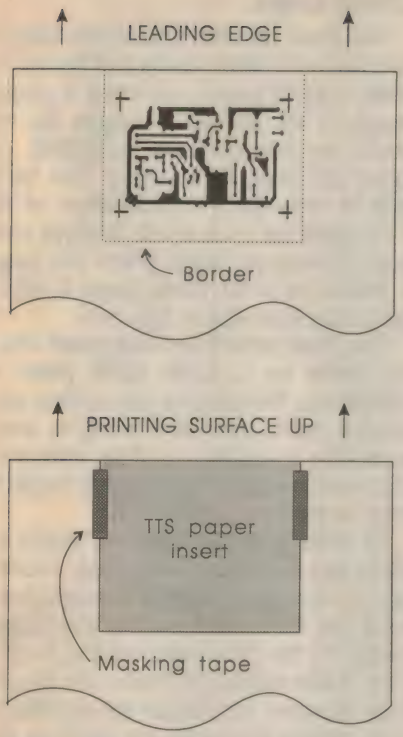


Fig.1: By making a trial print/copy first you can site the image near the leading edge of the paper. When this section is cut out around the border, a piece of TTS paper is inserted in the gap. By using this system to make the toner transfer image, there is no wastage of the TTS paper.

Just print out the pattern without flipping the image. The one reversal required will come when you transfer your pattern on to the back of the board.

Trying it out

We decided to try out the process using two different methods to make the PCB pattern on the TTS paper. The first image was produced directly from a laser printer; while the second was printed out double-size (for better definition) on a dot matrix printer, and then reduced back to actual size on a photocopier.

In order to reduce the cost (by using less of the special paper), we first positioned the image at the leading edge of the page, and then made a trial printout on ordinary paper to give its exact size and location. After adding a suitable border around the image, we cut out this section and filled the space with an insert of TTS paper — with the shiny side up (see Fig.1 on the next page). The insert was fastened to its carrier sheet with small pieces of masking tape, stuck on the top of the sheet. (You could also use correction and cover-up tape, but don't use plastic tape as it will melt in the printer/copier.)

Palmtech advises that it might take some experimentation to get a satisfactory image, as some toner cartridges do not work well with TTS. A dirty optical path or corona wires in the copier/printer can also cause problems. On your trial printout all filled areas should be solid black, and all white areas clean. The printout will also show up any problems with nonlinearity or incorrect size.

Fortunately, we didn't strike any problems in this area, with either of our two methods. But we did have trouble getting the entire image to transfer and stick to the copper surface. There is quite an art to doing a good job: thorough preparatory cleaning, sufficient ironing and careful removal of the TTS paper. Any of these stages can cause problems — for us, they occurred in stages 2 and 3. In fact, it took us half a dozen attempts before we achieved a satisfactory image transfer.

Cleaning

To help you avoid some of the mistakes that we made, here is the successful procedure that we eventually developed. We will assume that you have already sited your image, inserted your piece of TTS paper in its carrier, and printed your transfer image.

Now to the cleaning. For good adhesion, the copper surface must be perfectly clean and slightly roughened. We found that the easiest way to do this is to scrub the copper surface with a steel-wool soap-pad. When the surface is nice and shiny, a quick wash with soap and water will remove any fingerprints or smears. The board is then allowed to dry.

The type of PCB which we used had a fibre-glass base. Palmtech advise against using phenolic-based boards, since heat stresses can cause the copper to separate from this type of backing.

Toner transfer

Next comes the ironing. Position the PCB on top of the TTS image, as shown in Fig.2 on the next page. We tried several other methods before arriving at this configuration, including ironing the paper on top of the board (you'd expect this to be the logical way to do it), and sticking down all *four* edges of the TTS paper with the masking tape, rather than just two.

The tape is used to stop the two surface sliding across each other as you iron, so the more taping the better. However, removing the tape can become a later problem. Since the melted toner helps to stick the two surfaces together after ironing has commenced, we found that two pieces of tape were sufficient. But iron gently, especially in the early stages.

Raising the temperature evenly to the 150°C required is a bigger problem. Most domestic irons are light-weight, steam irons. This means that they have a low heat storage capacity, and the surface area is 50% holes. Such an iron is nowhere as good as the old-fashion solid model that it replaced, for the toner transfer process. But, with patience and extra time, the modern iron can be made to do the job.

Empty the water from the steam iron, and set it to 'cotton' to get the correct temperature. Place the paper and board on a firm surface, with sufficient insulation between them and your bench. We used a thick sheet of cardboard, covered with a tea towel and four layers of blank paper, sitting on a solid bench, to give a smooth insulated base. Remember that whatever you use is going to get very hot, and you don't want any additional toner (which will melt) on any of the layers.

Finally, cover the PCB with a few more sheets of blank paper, placing the supplied silicone-impregnated ironing sheet on top to protect the surface of the iron. You definitely don't want any transfers on to the iron, and then on to your clothes!

The secret to good ironing is to heat the board evenly. This is the reason why we turned everything upside down, because the heat transfer process — even if less efficient — is more uniform when the back of the board is ironed rather than the paper. Another advantage is that the paper seems to be less likely to slide around, since the heavier layer is on top.

Iron continuously in a circular fashion, without pressing too hard, and occasionally change the orientation of your iron. You get a more uniform heating if the board comes in contact with all sections of the iron. Remember that the edges of the pattern need to be ironed more — without this extra attention they tend to get less heat, and won't adhere as

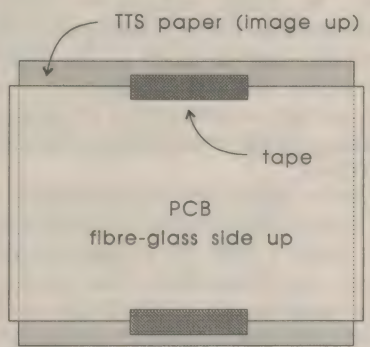


Fig.2: You would expect a better result by ironing the TTS paper on top of the copper side of the PCB. However, when placed upside down (as shown), ironing the fibre-glass side with a light-weight iron actually gives a more uniform heat transfer.

Toner transfer system for making PCBs

successfully (which happened in our first four attempts). You have to develop your own technique to suit your particular iron.

A good iron should take about 2 - 3 minutes for the transfer, but we found that we needed more like 4 - 6! It is better to over-heat than under-heat, even by several minutes. We also found that the image of the photocopier took longer to stick than that from the laser printer. Obviously, the type of toner involved is relevant to the time taken. And if you are making a board which is larger in area than the iron itself, this will further increase the ironing time needed.

The final stages

With the transfer complete, it's time to separate the layers. Pick up the TTS paper and board — but not with your fingers! — and place them in a container of water, paper side up. Soak immediately after ironing, as slow cooling causes the paper and board to contract at different rates, resulting in the paper lifting and bubbling. It is important not to interfere in any way during this soaking stage, as the soft toner can easily come adrift. So don't stir the water, and resist the temptation to try 'to help the paper off the board. We ruined one image trying the latter! Leave it to soak longer until it comes off by itself.

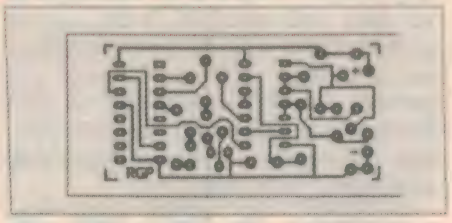
Usually, after about 1 - 2 minutes, the paper will detach itself and float off the copper surface. The masking tape will also separate, so it doesn't hold the paper down. We found no problem with this, even when we taped the paper to the board on all four sides. So, if you are have any trouble with the pattern sliding or twisting, use extra tape to secure it more firmly.

Quite often the transfer process will be more successful in some sections than others. So, before etching, we strongly recommend the use of a Dalo pen (or any direct etch pen) to touch up the pattern. This means that you can improve — or even salvage — your boards by filling in missing sections or touching up slight imperfections.

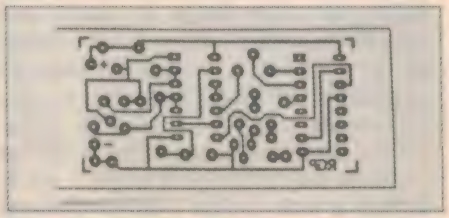
Another reason why it pays to touch up any faint or thin patterns is that the toner layer doesn't resist the etchant chemical as well as a Riston layer. You can see a slight break in one of the tracks on the smaller board we made (near the *EA* symbol), which would have benefitted by such treatment.

If any of your early attempts aren't worth fixing, you can scrub the toner off and re-use the copper board. The unwanted toner comes off more easily if you treat it with an automotive-type repair buffer, such as Tiptop Liquid Buff or Treadall Cleaning Buffer.

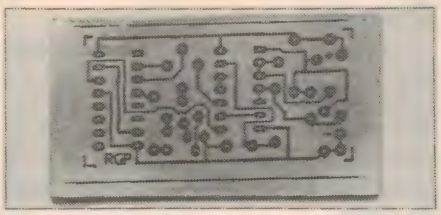
Finally, etch your board, and scrub off the toner pattern with steel wool. Ours came off more easily than expected, but then our etching took quite a long time because there was an overnight delay between making the pattern and the actual etching — the copper had started to tarnish. So it is better to etch as quickly as possible, merely letting the pattern dry long enough to harden the toner. This need only be a matter of minutes.



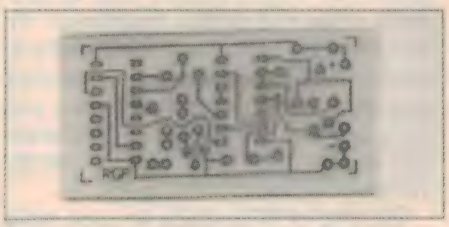
Step 1: Transparent film photocopy of EA artwork.



Step 2: TTS paper photocopy of transparent film mirror image of EA artwork.



Step 3: PCB after toner transfer ready to etch.



Step 4: PCB after etching and stripping.

Shown above are examples from the four steps in making a PCB for the 'Decision Maker' (EA, September 1992). The samples were provided by Palmtech, and the toner image was made on a Canon PC7 photocopier. The third step (the PCB prior to etching) is nowhere near as dark as it appears in the photo.

Other uses

The toner transfer system can also be used to make front panels and decals. To make a front panel, you need a *flipped* image of the artwork — again the opposite to that normally published. So again use your transparency film to be able to copy the reversed image on the TTS paper (or print it out reversed from your drawing package). When this image is ironed on to the panel, spray it with a protective layer once it has dried.

The photo shows the front panel which we made on a 2mm thick piece of aluminium. We cleaned the surface with alcohol rather than steel wool, to avoid scratching it; and then used the same ironing procedure, and for the same length of time, as with the copper PCB.

To make a decal (which we didn't actually do), no ironing is required. According to the manufacturer's instructions, what you do instead is spray the flipped image on the TTS paper with a lacquer base. After soaking in water, the lacquer base becomes the carrier for the image. This process is exactly the same as that used in making commercial decals — though done in the opposite order — where the images are silk-screened onto a lacquer base.

Summarising

We were quite impressed with the results of the toner transfer system — once we had mastered it. It offers a very easy method for home constructors to make their own boards. However, you must be prepared for a reasonable amount of experimentation before you perfect the method. This is because different toners, different irons and different ironing techniques all affect the rate and efficiency of the transfer. But once mastered, you can quickly and easily turn out your boards.

The standard kit from Palmtech contains five A4 sheets of TTS paper and one silicone-impregnated ironing sheet to protect the surface of your iron, together with full instructions. It costs $29.90 ($24.90, ex tax), plus $5.00 post and package, and is available from Palmtech, cnr Moonah & Wills Streets, Boulia 4829; phone (077) 46 3109, fax 46 3198. ❖

NOTES AND ERRATA

Noise & Distortion Meter (May/June 1993): Some MU-45 meters have the positive terminal on the right-hand side (looking from the back), while others have it on the left. In the latter case (on the left), components D1 to D5 and C20 should be fitted with the opposite polarity (orientation) to that shown in the component overlay diagram (June, page 64).

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HP 34401A Digital Multimeter	
DC Accuracy (1 year)	0.0035%
AC Accuracy (1 year)	0.06%
Maximum input	1000Vdc
Reading speed	1000/sec
Resolution	100 nV,10nA 100 μΩ

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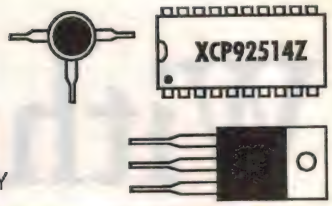


KEEPING YOU INFORMED ON THE LATEST DEVELOPMENTS IN SEMICONDUCTOR TECHNOLOGY

PWM controls laser dots

Controlling both the dot duty cycle and pulse position in laser printers, Analog Devices' AD9560 is an enabling IC for the next generation of printers. With this device, printers can provide 256 levels of grey scale image without the drawbacks of existing techniques.

Standard laser printers turn the laser beam either on or off for an entire pixel dot clock period and cannot provide grey scale printed images. To obtain high resolution grey scale, the AD9560 pulse width modulator precisely sets the duty cycle of the pulse driving the laser diode from 0 to 100%, in 256 steps. This in turn, controls the amount of toner deposited on any given pixel space. In addition, the pulse position can be set at the beginning, middle or end of the dot clock period, for additional control and effect.

Pulse width and placement can be changed with every clock cycle, up to a 50MHz rate, making this a very flexible circuit for pulse control. The AD9560 makes it possible to use a standard 300dpi 'engine' to its full capabilities, without loss of resolution.

A single resistor is all that is needed to match the nominal full scale range of this IC to the printer's dot clock range. An internal auto-calibration circuit compensates for any variation of the timing circuitry. This low power (335mW typical, 435mW maximum) device requires just a single +5V supply; all inputs and outputs are CMOS compatible.

For further information circle 271 on the reader service coupon or contact NSD Australia, Locked Bag 9, Box Hill 3128; phone (03) 890 0970.

Double balanced 2GHz mixer

A new GHz double-balanced mixer with high level output is available from Siemens. The PMB2330T excels in up and down RF carrier frequency conversion where gain is required and passive mixers need too much local oscillator power. In addition, Siemens has added to its family of digital wireless communications chips the PMB2312T, a prescaler with a 1.1GHz operating range.

The PMB2330T is a 5V, 1.6mA Gilbert cell mixer, which has a high input intercept and RF capability up to 2GHz. The mixer has a noise figure of less than 8dB and a gain of 10dB. It was designed for applications requiring an up or down conversion of receiver or transmit signals.

A standard part of the PMB product line, the PMB2312T chip complements the prescalers TBB202/TBB212A. It offers a low power operation standby mode (200uA), divide ratios of 1:64/65 or 1:128/129 and requires a low 5.5mA supply current, including preamplifier stages with no self-oscillation and a very low noise floor.

For further details circle 273 on the reader service coupon or contact Siemens Advanced Information Products, 544 Church Street, Richmond 3121; phone (03) 420 7345.

4Mb EPROMs

Advanced Micro Devices has introduced the AM27C4096 and AM27C400 four megabit EPROMs. Both devices have the storage capacity equivalent to 150 pages of 215 x 280mm text.

The four megabit AM27C4096 is organised as 256K x 16. This device provides a plug-in upgrade patch for customers currently using 16-bit-wide versions of the one and two megabit EPROMs.

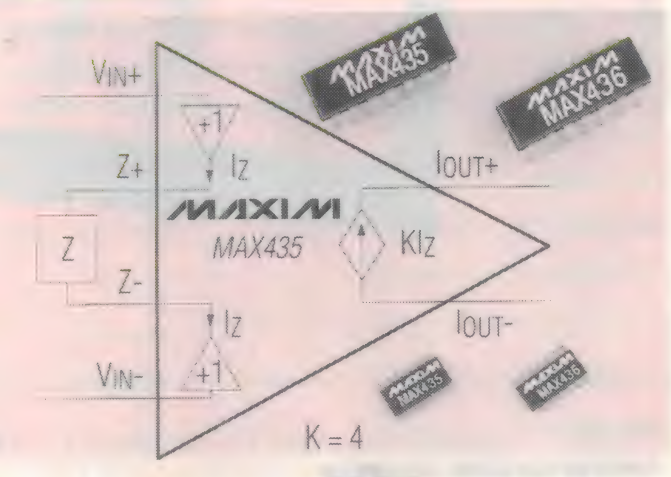
Differential amps need no feedback

The new Maxim MAX435/MAX436 wideband (275MHz) transconductance amplifiers have an architecture that provides extremely high common-mode rejection (53dB @ 10MHz) and accurate gain (+/-2.5%) without feedback. This feature eliminates loop-transmission phase shift which is a primary cause of parasitic oscillations.

Unlike current feedback amplifiers, these amplifiers have true differential and fully symmetrical high impedance input, enabling the MAX435/MAX436 to tolerate wide differential input voltages without saturation, thus eliminating overload recovery time.

The differential output MAX435 has a 275MHz bandwidth, 800V/us slew rate, and 18ns settling time. The single-ended-output MAX436 offers the same settling time with a 200MHz bandwidth and 850V/us slew rate. For high speed, low noise applications, the MAX435/MAX436 noise voltage density is an extremely low 7nV/√Hz at 1kHz.

Each output is a current source which generates a current proportional to the applied differential input voltage. Overall voltage gain is the product of an internal current gain factor (K) and the ratio of two external impedances. The MAX435 and MAX436 are ideal for high speed instrumentation amplifiers and high gain, wideband, bandpass amplifiers, and as high speed, differential line drivers and receivers.



For further information circle 272 on the reader service coupon or contact Veltek, 18 Harker Street, Burwood 3125; phone (03) 808 7511.

The AM27C400 is a four megabit ROM-compatible CMOS EPROM that is user-configurable as either 512K x 8-bits or 256K x 16-bits. This flexibility allows customers to choose an optimum organisation to facilitate easy interfacing between this high speed, high density EPROM and today's high performance microprocessors.

Both EPROMs are suitable for use in embedded applications such as laser printers, industrial controllers, communications equipment and in video games. They are manufactured in AMD's 0.85-micron CMOS process. Each device features a single 5V power supply, a standby static mode and fast single-address-location programming.

For further information circle 274 on the reader service coupon or contact VSI Promark Electronics, 16 Dickson Avenue, Artarmon 2064; phone (02) 439 4665.

Varactor designer kit

Alpha Industries of Wodburn, Massachusetts, recently introduced a varactor selection designer kit for designers of UHF and higher frequency VCOs. This new kit is a complete package featuring 96 surface mount varactor diodes representing 12 different types (five configured back-to-back), a selection guide, data sheets and a price list.

The diodes cover a wide range of VCO requirements. They include frequencies up to 3GHz and tuning bandwidths ranging from 5% to 100%. Applications include RF modems, pagers, cellular hardware, GPS equipment and mobile radios.

For further information circle 276 on the reader service coupon or contact Electronic Development Sales, PO Box 822, Lane Cove 2066; phone (02) 418 6999, fax 418 6550.

Multiple DMOS power transistors

A monolithic alternative to the use of multiple discrete power transistors or hybrid packages in power switching applications is now available from Texas Instruments.

This single-chip approach integrates multiple Double Diffused Metal-Oxide Semiconductor (DMOS) power transistors on a single substrate. The resulting devices give significant component cost savings over discrete solutions, and also improve reliability by minimising allotted board space.

The new Power+ Array family is well suited for power switching applications, including driving solenoids, motors, lamps, valves and relays. One device can do the job of several discrete power transistors, because it is capable of driving multiple loads simultaneously.

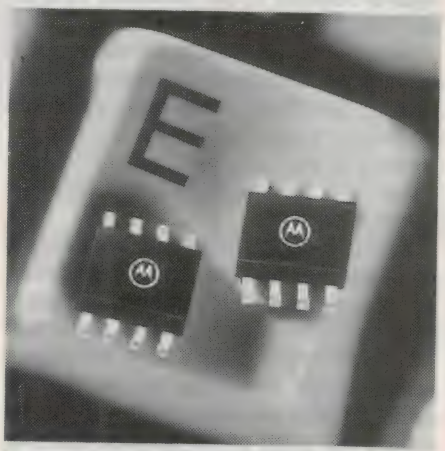
The Power+ Array devices are fabricated in a new TI one-micron process technology. This technology features a lateral DMOS structure that makes it practical and cost effective to fabricate multiple configured and fully isolated power DMOS transistors on a single substrate. TI claims that the process features a lower specific on-resistance than any existing merged DMOS process technology.

The initial four components in the new family feature fully-isolated lateral DMOS transistor pairs and multiple power transistors, configured for low-side drive. The TPIC2202, TPIC2301 and TPIC2701 integrate two, three and seven DMOS transistors; while the TPIC5201 has two independent DMOS transistors.

For further information circle 278 on the reader service coupon or contact Texas Instruments, 6 Talavera Road, North Ryde 2113; phone (02) 878 9000.

Fast bipolar logic translators

Motorola has added eight new translating devices to its ECLinPS Lite (E-Lite)



logic family. The E-Lite family uses Motorola's MOSAIC processes to provide state-of-the-art bipolar process speeds at competitive prices.

The design and packaging of the E-Lite translators simplifies system design, thus reducing the designers' total system costs. The flow-through pinouts allow board density to be maximised, and simplify the printed circuit board routing and layout. In addition, the low power feature eliminates the need to implement costly cooling techniques, and the high speed translation capability allows for higher bandwidth designs with low power consumption.

The eight new translating devices include differential Positive ECL (PECL) to TTL and TTL to differential PECL, as well as differential ECL to TTL and TTL to differential ECL functions. They are available in both 10ELT and 100ELT versions for compatibility with ECL 10H and ECL 100K respectively. The devices are specified over the industrial temperature range (-40 to +85°C) and have over 2000V of ESD protection, ensuring proper operation in the most demanding environments.

Targeted for applications in the automatic test equipment, instrumentation and communications market, the E-Lite family provides superior isolation over multiple gate logic. The space efficient and cost effective eight-lead SOIC package makes it ideal for pin cards and applications that require density, but not at the expense of signal integrity.

For further information circle 275 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 887 0711.

3.3V erasable PROMs

WSI has released fast 3.3V UV-erasable CMOS PROMs, with a maximum read access time of 70 or 90ns and a chip-select-to-valid-data-out-time of 20 or 30ns respectively.

These 2K x 8 devices meet or exceed the access time required for zero-wait-state operation with any 3.3V microcontroller, microprocessor, or DSP. They are especially well suited to DSPs, such as the TMS320LC15, where fast access times are critical to zero-wait-state operation. In addition, fast 3.3V look-up tables, state machines, and function generators can be implemented with these low voltage PROMs.

WSI's low voltage EPROMs are ideal for real-time, battery-operated products, such as hand-held telecom equipment, portable data recording equipment, or embedded mobile applications. They will support 3.3V processors with clock speeds between 12MHz and 15MHz in laptops, palmtops, and personal organisers with no wait-states. They can also help to further extend battery life by reducing the power requirements of small disk drives and other low-power peripherals that are used with portable computers.

WSI's 3.3V PROMs are claimed to be nearly twice as fast as any other available low power PROM. Hence designers of low power products who require real-time operation, but have been forced to introduce wait-states because of slow PROMs, can now improve their systems to a zero-wait-state performance by upgrading to these parts.

For further information contact Zatek, PO Box 397, West Ryde 2114; phone (02) 874 0122, fax 874 6171. ❖

CAD Software Review:

Protel's Schematic for Windows

Tasmanian-based Protel Technology has now released the updated successor to its popular schematic drawing package, Schematic 3.3 for DOS. The long-awaited and much enhanced *Advanced Schematic for Windows* (V1.0) offers an impressive range of new features including simultaneous multi-sheet editing, instant library editing, overall project management, high-quality printout, plus much more.

by ROB EVANS

In the August 1990 issue of *Electronics Australia*, Jim Rowe took a look at Protel's then-current circuit drawing package Schematic 3.3, and with just a few reservations, was very impressed. To put it briefly, he felt that the program was very practical and easy to use, yet was a letdown by virtue of both the resolution of the final printout (around 100dpi) and the rather quirky nature of the associated component library editor SLM. On the strength of this we've been looking forward to the *next* release of Protel Schematic, in anticipation that it might offer a much higher printing resolution and use a more robust component editing scheme — rather like its sister PCB design package, Autotrax.

As it has turned out however, Protel took the bull firmly by the horns and completely re-wrote their schematic package from the ground up, rather than simply upgrading the existing software. Now called an *Advanced Schematic Capture System* (wow!), the current program operates on the Windows platform and quite frankly, bears little resemblance to its predecessor Schematic 3.3 — for a start, it's a *much* more sophisticated program. Together with Protel's new circuit board design package *PCB Design for Windows*, these two integrated programs form the nucleus of Protel's thrust into the high-end of the CAD software market under the banner of *Protel for Windows*.

When you think about it, it's not really surprising that Protel have embraced the Windows platform for their newest range of CAD software. Windows offers a ready-built structure which is able to take charge of just about all of a CAD program's peripheral tasks — such as printer management, screen graphics, disk access, memory allocation, on-line help, file management, and so on. This in turn means that the actual program (in our case, Schematic) can be 'dedicated' to the task of developing circuit diagrams, without the need for reams of additional code to provide the 'user interface' — instead, it harnesses the built-in features of the Windows Graphical User Interface (GUI).

As a further advantage, Windows' GUI has the infrastructure to support *multi-tasking* operations, where you can switch between a number of programs which are running at the same time, and *direct link* capabilities for instant data exchange between programs.

And as a bonus, Windows also offers a common user interface for all Windows-based packages, which in practice means that once you have used just about any Windows application, a *new* program's screen layout and menu system will be quite familiar — this certainly helps to reduce the slope of the dreaded learning curve which always seems to accompany CAD software.

So while many of us might find Windows to be less attractive than more conventional programs, due to its hunger for computing power and system memory (often for little apparent gain), it does seems ideally suited to high-power CAD packages such as Protel's Schematic.

The package

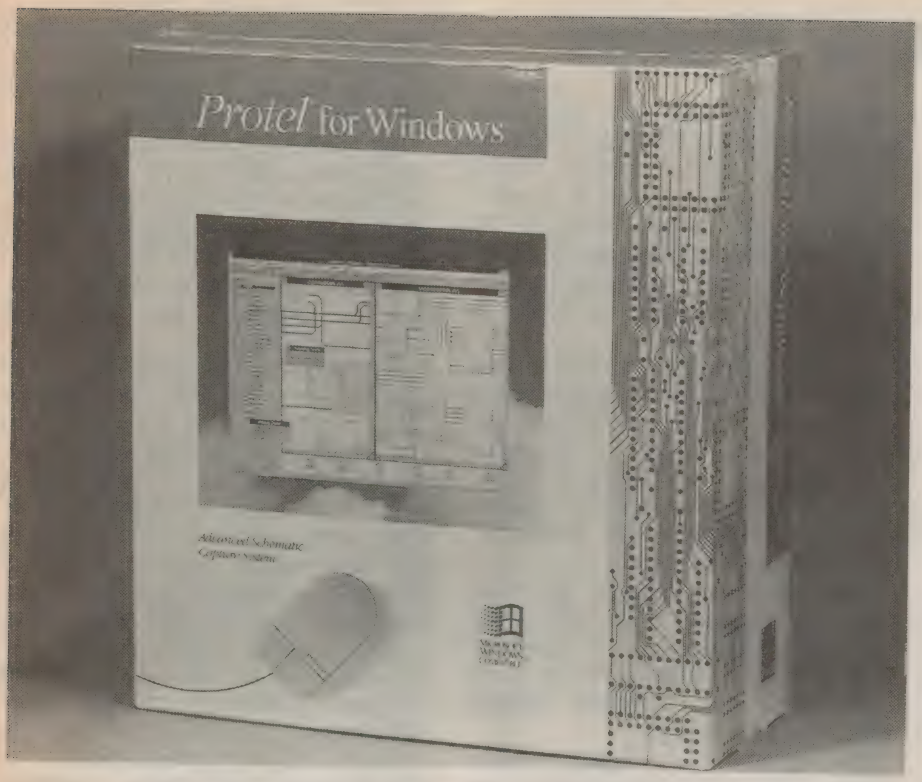
Protel Schematic is suitable for PCs running Windows version 3.1 in 'standard' or '386 enhanced' mode — which in effect, sets the minimum hardware requirements for the package to a 80286-based machine.

Like many other Windows software packages however, you would probably find that Schematic behaves in a rather sluggish manner when running on such a machine, and consequently an 80386SX (or better) machine is highly recommended. Note that besides the sheer increase in computing speed, the 386 and 486 processors allow Windows to run in its 386 Enhanced mode, which offers access to the GUI's virtual memory and full multi-tasking capabilities.

Other than the above hardware requirements, Schematic for Windows will also need a machine equipped with a sizable hard disk, since while the program itself only occupies about 4MB of your precious disk space, the *accompanying* software has much higher storage demands. For example, Schematic's component library files can take up more than 500KB of disk space each, and if you load all of the supplied libraries during Schematic's installation, you'll find that the 'library' sub-directory occupies around 10MB of the storage area. Save a few drawing files, and the total Schematic program will have consumed more than 15MB of your hard disk space.

Further to this, it's an interesting exercise to consider the requirements of a machine that you may be setting up just for a particular CAD system, such as the complete Schematic and PCB design package *Protel for Windows*.

In this case, the hard disk will need about 2MB of free space for DOS (version 5), 15MB for Windows, 15MB for Protel Schematic, and say 10MB for Protel PCB Design; a total of 42MB. And of course you will probably end up using the newly-released DOS version 6, which has bloated its way out to about 7MB, increasing our overall consumption to around 47MB. Gone are the days when a 40MB hard disk was considered a respectable mass storage device...



It's important to note that this situation can't really be construed as a criticism of Protel's new software, however. Rather, it merely represents the current state of software and hardware development where as programs become larger and more powerful, hard disk capacities are simply expanding to suit the need — and in the process, costing much less for each megabyte of storage area.

As it happens Schematic's storage requirements are quite typical of other Windows-based software, and if Windows 3.1 is already installed on your machine, you will only need to reserve between 5MB and 15MB of disk space for Schematic, depending upon how many of the supplied library files you wish to install. So all in all, what is currently considered as an 'entry level' machine — a 386SX system with say 2MB of RAM, and an 80MB hard disk — should run Protel Schematic quite nicely.

The *Schematic for Windows* package itself comes in a neatly presented box containing both the software (on three high-density 5.25" disks in our case), and four instruction manuals; these are an overall Environment Guide covering *Protel for Windows*, a User Guide for the schematic package, and reference manuals for both Schematic Capture (the actual drawing section) and the component Library Editor.

Also included is a copy-protection hardware 'dongle', which must be plugged into the machine's parallel printer port before the program will run. This is of the 'intelligent' type, where the various parts (or modules) of *Protel for Windows* become permanently activated once the user has entered a unique access code, as supplied by Protel. When it comes to adding a new module or upgrade, a new access code is provided — after payment, or course...

Operation

Installing *Schematic for Windows* couldn't be easier. With Windows already running, you simply use Program Manager to execute Schematic's setup program from the master floppies (using the 'File Run' option), answer a couple of questions (destination directory, etc), and sit back while the software does the rest.

As well as decompressing then transferring files to the appropriate directories, the setup program then creates a suitable Windows program group (labelled Advanced Schematic) and adds icons for both the schematic drawing and library programs (titled Schematic Editor and Library Editor, respectively). Once you've set the dongle access code as mentioned above, the program is ready to go.

As you would expect from a schematic drawing CAD program, Schematic allows you to place library components on the work 'sheet', type in appropriate labels (R7, C20 etc) and values (22k, 47nF etc), drag parts to the desired positions, and link them together (using 'wires') as defined by the circuit. In fact this sort of basic drawing activity is extremely intuitive in Schematic, and we were able to complete a trial circuit diagram in short order without having to refer to either the supplied manuals or the on-line help system.

The menu system works just as you would expect from a Windows application, where using the mouse to click on the menu title (say, Zoom) will cause a list of the various options to drop down, and these in turn can be selected by the same point-and-click method. Alternatively, the ALT key can be used to activate menus (ALT+Z for Zoom) and the underscored character pressed to select the option (say 'I' for In).

In addition to this standard menu system, Schematic also offers a Toolbar facility which provides command shortcuts for commonly-used features. This appears across the top of the screen as a row of mouse-activated 'buttons', each having a small graphical representation of its function — for example, the Zoom-In button has a picture of a magnifying glass with a '+' sign in the centre.

To further speed operations, you also can program a list of keyboard 'Hot Keys' (or mouse clicks) to perform particular tasks — to use the above example, the 'I' key or perhaps a double click on the right-hand mouse button could be assigned to Zoom-In function.

These, plus a number of other time-saving shortcuts offered by Schematic make the program both fast and very easy to use — and if you need help, the context-sensitive help system is only a mouse-click away. The standard Windows-based help system really does work well, and in the case of Schematic, it's so thorough that we found very little need for the manuals while evaluating the package.

The other circuit drawing aids in Schematic are pretty much what you would expect from a serious CAD package. Just as in Schematic 3.3, the program offers snap and visible grids, a range of sheet sizes (A4, A3, etc), user definable screen colours, and full 'block' manipulation, which is now arranged as the more conventional cut, copy, and paste operations. You also have full control of the components on the sheet with the move, drag, search for (find), change (edit), jump to, and delete features — plus the ability to perform *global* changes across the sheet (which is far more powerful than in V3.3).

It's beyond this level however, when the sophistication of *Schematic for Windows* really begins to show. For a start, Schematic makes full use of Windows' multi-tasking capabilities by allowing the user to open a number of sheets at the

same time, then to instantly switch between and edit each sheet.

While this may seem unnecessary for unrelated circuits — there's limited benefit in editing say your Wobbulator circuit at the same time as your Phantastron design — larger, more complex circuits are usually broken down into a number of smaller, but electrically connected schematics. With *Schematic for Windows* a number of sheets can be created, saved and loaded as a single *project*, and dealt with in a 'hierarchical' manner.

The tree-like structure of this hierarchy is rather like the directory/sub-directory relationship of DOS file management, where the master (root) directory shows the available directories on that disk drive, and the individual directories may contain sub-directories, which in turn can have sub-directories, and so on. With Schematic's project management system, a master sheet might show a number interconnected sheets (represented as blocks), while each individual sheet may also contain blocks representing further sub-sheets, and so on.

In practice, the depth of this hierarchy is only limited by the number of sheets that can be opened at any one time, or in effect, the computer's available memory.

To help you make sense of complex multi-sheet structures, Schematic offers a Project Manager window which displays a 'tree' structure representing the (hierarchical) relationship between the sheets in the current project. This feature also allows you to quickly navigate your way between sheets by simply clicking on the appropriate sheet icon in the tree itself, and keeps track of the links between each sheet.

To maintain a flexible linking system between sheets in a project, Schematic offers a number of different ways to define these interconnections. Dubbed 'net identifiers' — since in CAD terms, connections are defined in a netlist — the connection objects can be 'sheet entries' (the blocks mentioned above) which identify sub-sheets in a vertical hierarchy, 'ports' which connect sheets in the horizontal sense, and 'global' links such as power ports (say Vcc) which effectively connect to all sheets.

While as you would expect, these interconnections can become extremely complex in a large project, the system allows Schematic to maintain an accurate relationship between sheets in an elegant and flexible manner.

And so that the work isn't wasted, Schematic can then save the whole structure (including the project's tree arrangement) under a single project filename — this is usually a 'master' sheet for that project. Then as the project is opened at a later date (by loading the master sheet), Schematic automatically reloads the appropriate sheets as noted in the project tree.

Since the components used in a sheet may have been plucked from any number of Schematic's library files (including your own), the program has the rather neat scheme of maintaining a special 'cache' library for each project or sheet, which holds copies of just those components used in the circuit.

When the sheet is saved, this mini-library is appended to the end of the sheet file, allowing you to reload or pass on the file without having to access all of the component libraries used to create the design.

You can also save a separate project library, which will include all of the components used in a particular project, for all of the included sheets. As well as being an efficient way to access the components for that project, this library won't be effected by any changes made to the master library and will therefore remain relevant to its associated project. As you would expect, since this is a genuine (albeit small) library in its own right, it may be edited like any other.

While *Schematic for Windows*' project capabilities are one of its key features, it also offers a number of other significant improvements over its predecessor, Schematic V3.3. For a start, the new version is much more like standard drawing package when it comes to placing lines, shapes and colours on the sheet.

By activating the Drawing Toolbar (or using the menu system), you can place lines, polygons, arcs, Bezier curves, text, text frames, rectangles, rounded rectangles, elliptical shapes, pie shapes, bitmaps, or an array of components from the program's clipboard. The solid shapes (rectangles, polygons, and so on) can be filled with any of 256 available colours, while the lines used to form all shapes can be of four different widths and any of the above colours.

By the way, the clipboard mentioned above has nothing to do with Windows' own clipboard system used to exchange information between programs, and simply works *within* Schematic via the cut, copy, paste, and paste array functions. While these capabilities are quite valuable in their own right, it's a pity that you haven't the flexibility to paste a section of a Schematic diagram into another Windows application — as is the case for most other Windows software.

The toolbar's Place Bitmap option is quite open-ended, on the other hand. By clicking on this button you can call, place, and *re-size* graphical images which conform to PCX, BMP, GIF, TIFF, or EPS formats — just the shot for inserting your company logo into each schematic diagram...

Bells and whistles aside, the actual *drawing* power of Schematic competes quite favourably with many dedicated drawing packages, allowing you to create elaborate and very professional looking results. This is also helped by Windows' ability to manage text in a wide variety of sizes and styles — which in the case of Schematic are available as scalable TrueType fonts — and its capacity for driving a host of output devices, ranging from dot-matrix printers through to 1200dpi Linotronic photosetters and high-resolution plotters.

For the more conventional job of defining the connections between component objects, Schematic also offers a Wiring toolbar which provides menu shortcuts for placing connecting wires, bus lines, network labels and information, power connections, junctions, plus intersheet symbols and ports.

And as you would expect, the components themselves can be extracted from any Schematic library, then placed, moved, rotated and re-defined as you wish — note that you can load any number of libraries during editing (memory permitting), and instantly switch between these using the mouse.

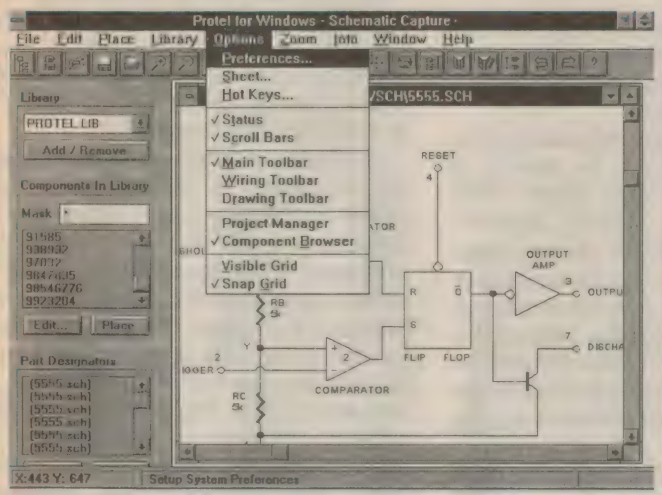
However, if you can't find a suitable component in the available libraries, it's time to create a new part or modify an existing component...

Library Editor

We're happy to report that Schematic's new component editing system has come a long way from V3.3's somewhat idiosyncratic Schematic Library Editor (SLM). While the new Library Editor is a separate executable program like its predecessor, it offers direct links to the Schematic Editor and can be invoked from within that program in several different ways.

On the most basic level, you can simply use Windows to start both Schematic's circuit editing and library programs, and switch between the two using the standard task-swapping keys (control- tab, etc), or by simply minimising and maximising (Window's expressions, not ours) the applications as required.

Fig.1



Screen 'shots' of Schematic in action: Fig.1 shows the schematic editor with the Component Browser activated (on the left of the screen) and the Options menu selected — the 'protel' library is used to convert Schematic 3.3 files into the new format. In Fig.2 an eight sheet 'project' has been loaded, and the 'cpuclk' circuit selected for editing — note the program's main toolbar near the top of the screen, which is used for command shortcuts. Schematic's library editor is shown in Fig.3 with the drawing toolbar activated (lower centre of the screen), and the 'device' library loaded.

Fig.2

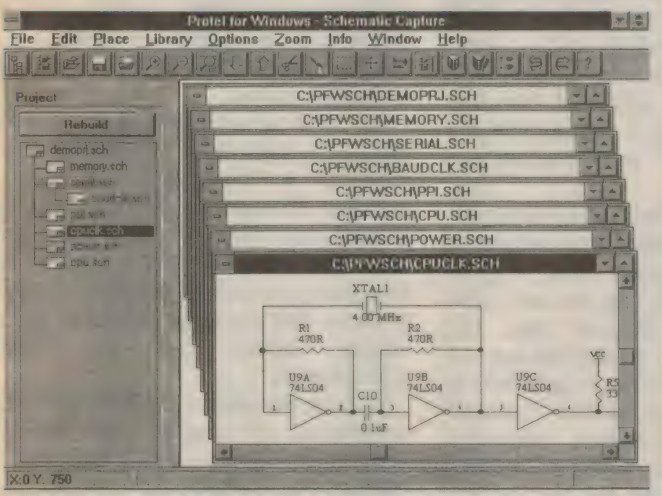
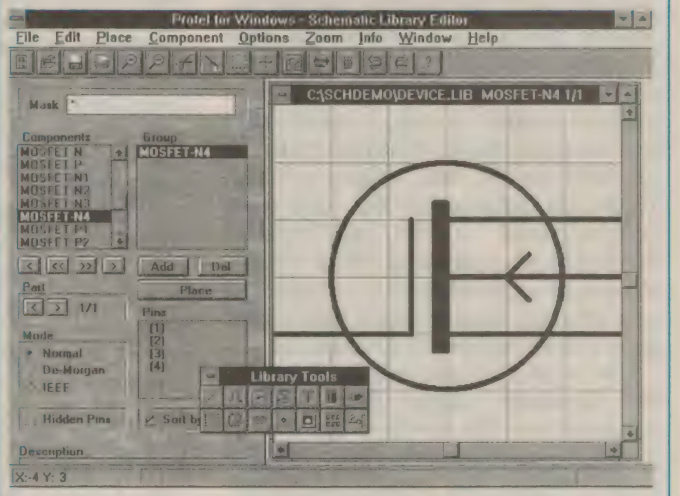


Fig.3



The much more direct method however, is to start the schematic editor in the normal way (double-clicking on its icon) and when you need the library editor, simply click the 'Switch to the Schematic Library Editor' toolbar button.

This both 'launches' (loads) and switches to the library program in one hit, and from that point on acts as a task-switching shortcut button. Not surprisingly, the Library Editor offers the equivalent 'Switch to Schematic Editor' button which operates in the same fashion.

The other set of complementary commands are the 'Edit' button in the schematic editor's component browser, and the 'Place' button in the library editor's main panel. Here, 'Edit' switches to the library editor and calls the component that is currently displayed the schematic component browser, while 'Place' switches to the schematic editor and places the library editor's current component onto the sheet. With any of these methods, you can rapidly swap between each program at will, which tends to smooth out the whole task of creating a schematic.

To further speed operations, the two programs offer direct, and effectively *dynamic* links in library operations. For example, in the library editor you can activate the Update Schematic Editor command, which automatically updates any parts in an opened schematic sheet (in the schematic editor) which match the component in the current library editing window.

This takes the place of saving the current library file, switching to the schematic editor, loading the relevant library, then finally updating the sheet by replacing the components with the new version.

The first thing that you notice about the operation of Schematic's library editor is that it includes many of the same menu commands, tools, and capabilities of the schematic editor.

Virtually all of the graphic drawing options, editing functions (cut, paste, etc), screen layout and options, and toolbars operate in the same manner, which helps to provide a consistent operating procedure between the two programs.

Just as in the schematic editor, you can open multiple files and jump between them at will, print the current work sheet (in case, a single component), and perform elaborate global change operations.

Other than that, it creates, edits and saves component elements pretty much as you would expect from such a program. And thanks to the sophisticated drawing tools available in the library editor, you can create quite complex components without any real restrictions.

Protel's Schematic for Windows

In practice

Having used Schematic 3.3 for some time, changing over to *Schematic for Windows* proved to be somewhat of a culture shock since it really is a much more elaborate program in terms of flexibility and sheer drawing capabilities. By its use of vector rather than bitmapped graphics (as in version 3.3) and the Windows GUI, the program has very little in common with the previous release — both in its basic approach and operation.

Despite this we managed to master the software in relatively short order, thanks to the very comprehensive on-line help system and the intuitive nature of the menu system. Not surprisingly though, there were a few quirks...

The first problem occurred during the installation procedure, where to cut a long story short, we found that despite the reassurances of the supplied documentation the package *wasn't* compatible with Windows version 3.0, and needed the latest V3.1 to run. There was no error message to point this out; it just couldn't find a number of files which are exclusive to Windows 3.1, and refused to load. While the solution to this was quite straightforward — we just installed Schematic on a machine which was already running Windows 3.1 — it did suggest that the documentation hasn't kept pace with the software's development.

Like most other new software however, the Schematic master disks hold a 'read.me' text file which is intended to inform the purchaser of the latest changes to the program. But because this is normally read *after* the program has been installed (as it's often held in unreadable compressed form on the floppies), it was of little help to us, since we couldn't actually install the software...

The funny thing is that when we eventually scanned through the read.me file, we found that while it thoroughly covered a number of alterations to the program itself, there didn't appear to be any reference to this changed Windows compatibility. Hopefully, the Protel sales people are pointing out that Windows V3.1 must be used with Schematic. Other than that there were only a few other niggly problems with Schematic, which although minor, we thought we'd mention as a gentle prod for future improvements.

One problem that kept cropping up was the program's inability to remember some worksheet options, such as the snap grid setting. While this information is apparently saved with each schematic sheet and automatically restored when the work is reloaded, we found that they were not active until you clicked on 'OK' in the settings menu. The snap grid for example, always defaulted to 10.

Next on the list is the awkward method for selecting arc objects for moving or editing. Unlike the other shapes which can be selected by clicking anywhere within its perimeter, the mouse cursor must be pointed exactly at the arc's beginning or end node before it can be selected. Now when the arc tool has been used to make a *circle*, the start and end nodes are at the same point and their positions are not apparent — all that you see is a circle, without a 'beginning' or 'end' point.

Another minor problem for Schematic users is selecting the most appropriate printer options — although this is more of a trap for the unwary, rather than a shortcoming of the program itself. This snag became apparent when we noticed that the colour sections of the schematic sheet were (understandably) being printed as scales of grey by our monochrome laser printer, which detracted from the quality of the printout — for example, the red junction 'blobs' were coming out somewhat fuzzy.

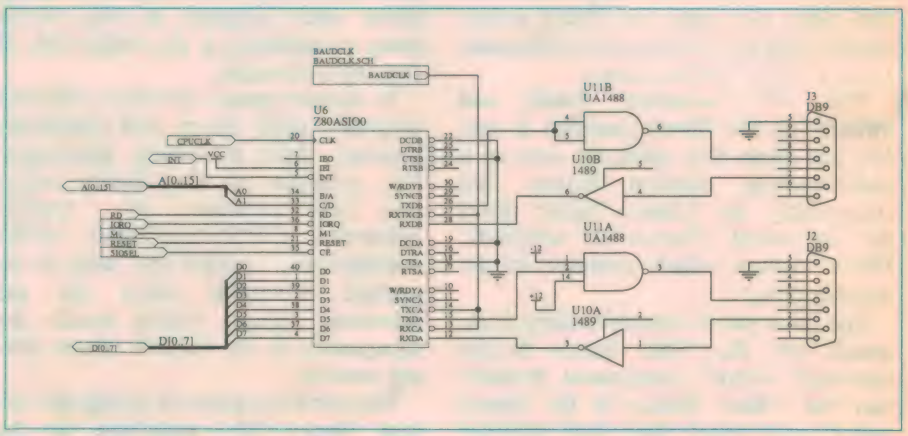
In an attempt to correct the situation, we selected the Monochrome setting in Schematic's printer setup menu, only to find that any solid fills (say, the inside of a rectangle) in the diagram were not printed. A quick scan through the manual confirmed that this setting is intended for low-resolution monochrome printers (such as a 9-pin dot-matrix), where apparently, you only want a shape's outline.

As it turned out, the solution was to select 'print all colours as black' in Windows' Printer Advanced Options menu, while leaving Schematic's printer options in the colour mode. Perhaps we're being pedantic, but it would have been nice if this combination of options was suggested by Schematic's manuals or on-line help system — a monochrome laser printer is surely the most likely device to be used with this program.

The other point that we noticed regarding the printout is that there is no real option for printing just a section of the schematic, rather than than the whole worksheet. This means that if you have drawn a small circuit with just a few components for example, the only way that you can create a larger printout is to use the print manager's scaling option — say, to print at 200%. The problem with this solution is that since the overall area of of the printout is defined by the sheet's border lines (whether they are turned on or off), the program will send *four* pages to the printer in order to printout the total area — and there's no guarantee that your circuit isn't positioned on a break between two of these pages. A 'print selected items' option (with the usual scaling capability) would be a nice addition to Schematic.

The final point concerns the amount of disk space taken up by Schematic, and is more of a 'wish-list' entry than a criticism. This point came about when we noticed that while the actual program takes up about 4MB of space, the library files occupy a substantial 10MB of your precious disk capacity — and by all accounts, appear to be highly 'compressible'.

In short, this means that if some kind of compressed file format was used for Schematic's library files, the overall package would take up far less disk space. Just how much less is open to question, but we found that if the libraries were processed by one of the common archiv-



A sample printout from Schematic, shown here at a reduced size. Since the program can now drive Postscript-compatible printers (thanks to Windows' print manager), the output resolution is limited to that of the printer rather than the software — in our case 300dpi.

ing programs (*lharc, pkarc, pkzip,* etc), the files were reduced to a little more than one-tenth of their original size — a saving of around 9MB. Regardless of the above points though, we'd have to say that we were very impressed with the capabilities and operation of *Schematic for Windows*. In most aspects of the schematic drawing process, the new software really is in a different league from version 3.3.

Schematic's peripheral functions have also been improved over those available in the past version. As well as the traditional Bill of Materials (BOM) report, the program can generate Cross Reference and Project Hierarchy data, perform Electrical Rules Checks (ERC), and generate Netlists in a range of formats. As you would expect, its main Netlist format is suitable for Schematic's sister program *Protel PCB for Windows*, where it's used for auto-routing information.

And so that your past work isn't wasted, Schematic also allows you to directly import Schematic 3.3 and OrCAD files and libraries. As you would expect from a regular user of Schematic 3.3, we were keen to try out this feature.

When version 3.3 files are loaded into *Schematic for Windows*, the program effectively scans the bitmap image of each part, then generates a proprietary bitmap code number and checks this against the components in the supplied Protel library (protel.lib) — a reference library for this express purpose. When it finds a matching code number in the library, this high resolution vector-based part is automatically included in the schematic in place of the old chunky bit-mapped image.

In practice this scheme works quite well, and only tripped up when it encountered some of the more unconventional components that we'd created ourselves in version 3.3. When this occurs, the program simply performs a bitmap-to-vector conversion on the unrecognized component.

The old V3.3 library files are converted in a similar manner, after first using SLM to decompile the structure into a raw bitmap form (with the .src extension). As with our old circuit files, there were a number of components that the Schematic conversion process couldn't cope with — however in this case, they actually caused the program to stop and report an error.

Conclusions

On the whole, we're very impressed with the overall *Schematic for Windows* package. There's no doubt that it's capable of delivering extremely professional results which wouldn't look out of place in the manual for a piece of commercial gear, and it offers the flexibility to help streamline the process of creating schematic diagrams.

While it has the reasonably steep learning curve that you expect from a powerful CAD package, the basic functions are quite easy to master thanks to the intuitive nature of the menu system, the excellent on-line help system, and the quality of the documentation (which will be even more helpful when it's up to date). By using the Windows platform and completing what must have been an extensive development process for Schematic, Protel have produced a package which must rate alongside the world's best in circuit CAD systems. It's certainly a quantum leap up from our old friend, version 3.3.

At the time of writing, *Advanced Schematic* is available for $795 as an upgrade from Schematic 3.3 or OrCAD, or for $995 as a new licence. Protel also offers a range of 'Productivity Packs' which include various combinations of *Advanced Schematic*, the complementary *PCB Design*, and site licences for up to 10 users.

For more information on Protel's CAD products and the current price structure, write to Protel Technology at GPO Box 204, Hobart, Tasmania 7001. Alternatively, you can phone (002) 73 0100 or fax your query to (002) 73 0944. ❖

NEW PRODUCTS

Optical/mechanical tachometer

The Pantec DTM 30 is a handheld, rugged and easy to use contact and non-contact optical and mechanical tachometer. It features a five digit LCD display, three measurement functions (rpm, m/min and yards/min), five data memories and an auto power-off function.

The HI-LO measurement ranges cover the ranges of 60.0 to 3000.0 and 60 to 30,000rpm, 6.00 to 300.00m/min and 6.0 to 3000.0m/min, as well as 6.56 to 328.09yd/min and 6.6 to 3280.9yd/min. The unit comes complete with carrying case, and various adaptors and accessories.

For further information circle 242 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2015; phone (02) 698 4775, fax 699 9170.

Handheld GPS receiver

Panasonic's KX-G5500 is a compact (130 x 65 x 35mm) handheld GPS receiver which offers all the benefits of portability and easy operation. This five-channel C/A code receiver stores up to 99 waypoints and nine reversible routes. It's powered by a long lasting, rechargeable nickel/metal hydride battery, or the AA alkaline battery pack that is supplied. A lithium battery serves as a memory backup.

The Panasonic KX-G5500 is ideal for use on land and sea. It comes complete with external antenna, antenna/DC adaptor, adjustable mount, carry case, battery charger and AC adaptor, and alkaline battery case. Like all GPS receivers, the KX-G5500 is subject to a degradation of position of plus or minus 100m, as determined by the US Department of Defence.

DSP-based waveform analyser

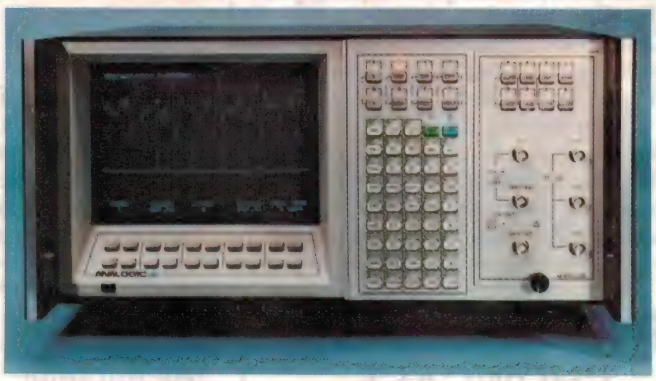
Analogic has released the Model 6500, claimed to be the first DSP-based Universal Waveform Analyser, with throughput speeds over 50 times faster than any other analyser in its class.

Ideal for testing and evaluation where instantaneous results are demanded, the Model 6500 can be used as a benchtop or ATE instrument for applications in sound and vibration, medicine, seismology, sonar, radar, telecommunications and interactive biomedicine.

The Model 6500 is the latest in Analogic's family of signal acquisition and processing instruments. Incorporating a 32-bit floating point digital signal processor (DSP) slave to the mainframe CPU, the analyser achieves throughput speeds of 25Mflops for real-time signal processing and spectral analysis.

All mathematically intense vector calculations and many scalar calculations have been transported to the Model 6500's DSP subsystem, to provide real-time processing in both the time and frequency domains on records as large as 32k data points. In addition, the DSP subsystem includes a large memory for storage of both intermediate and final results generated by the processor, greatly improving the processing efficiency of the instrument.

A second major feature of the analyser is an MS-DOS compatible 40MB hard disk. Capable of communicating with two external floppy disks, this subsystem includes two RS-232 ports, as well as single IEEE-488 and HPGL ports.

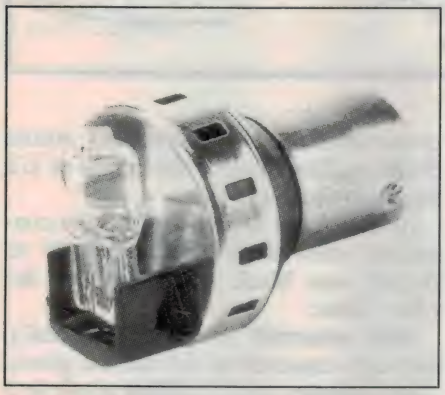


In addition, the Model 6500 software features simple downloading of program, data, and control sets. The program set includes branding, looping, and decision-making capabilities that significantly improve the performance and throughput of the instrument.

For further information circle 241 on the reader service coupon or contact Kenelec, 48 Henderson Road, Clayton 3168; phone (03) 560 1011, fax 560 1804.

For further information circle 242 on the reader service coupon or contact Panasonic Australia, 1 Garigal Road, Belrose 2085; phone (02) 986 7400.

Back-up alert



Reversing alarms already provide proven safety benefits on forklifts, large trucks and construction equipment. Now the Back-Up Alert offers similar protection for private vehicles, taxis, couriers, delivery vehicles, and the host of cars and commercial vehicles in Government and business fleets.

Back-Up Alert replaces the existing reversing light globe in any motor vehicle, to perform the dual functions of both a reversing light and an audible alarm. Every time the vehicle shifts into reverse, the unit lights up and emits a 'beep, beep, beep' warning alarm, thus substantially reducing the risk of accidents.

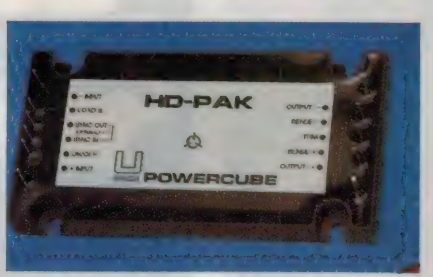
The device employs microtechnology to minimise its size, and has the same bayonet fitting as the standard reversing light globe that it replaces. It consists of a tiny 20W halogen globe with a mirrored reflector, which reflects more light than most existing reversing globes.

The remaining space contains a miniaturised electronic alarm which emits a signal of 82dB. This level provides an adequate safety warning to alert anyone behind the vehicle. Back-up Alert replaces standard 1156, 1073, 1076 and 1141 bulbs — it is not compatible with 3156 bulbs. Its RRP is $59.90.

For further information circle 247 on the reader service coupon or contact Supply 2000, PO Box 42 Galston 2159; phone (02) 653 2000, fax 653 2191.

High density DC-DC converters

Powercube's new HD-PAK high density industrial converters are an entire family of 300W DC/DC converters, designed for the telecommunications, computer markets and general purpose applications. The HD-PAK operates at 350kHz and offers efficiencies of up to 90%.



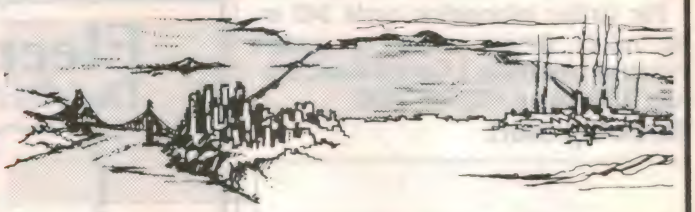
These industrial converters feature Advanced Integrated Magnetic Technology, the basis of all Powercube's high power military power supplies.

This new technology makes possible a high power density of 54 watts/cubic inch in a module 116.8 x 61 x 12.7mm in size, and weighing only 178g. The modules are protected against over-current, over-voltage, and 105 - 115°C over-temperature, shutting down auto recovery. They can also operate over a wide input range.

The 48V DC input module has a 36-76V DC operating voltage. The input to output isolation voltage for the HD-PAK series is a high 3750V RMS.

For further information circle 246 on the reader service coupon or contact Priority Electronics, 1/23 Melrose Street, Sandringham 3191; phone (03) 521 0266, fax 521 0356. ❖

Silicon Valley NEWSLETTER



Xerox & AT&T announce 'super flat display'

The prospects for the establishment of a competitive US flat panel display industry have received a huge boost, as a consortium of companies led by Xerox and AT&T announced the development of a new flat panel display that is no thicker than a notebook and features a resolution as detailed as a colour photograph.

The display was developed at Xerox's Palo Alto Research Center (PARC), in cooperation with AT&T's Bell Labs and Sandish Industries.

The group is now seeking federal subsidies to help build a joint US$300 million manufacturing facility, to produce the displays in high volume for the commercial market and at prices that would compare favourably with similar product from Japan.

Officials at the White House said the Clinton Administration welcomed the breakthrough and may provide up to US$50 million this year to help construct a prototype factory in Palo Alto.

The Xerox-AT&T display offers nearly twice the detail of any current LCD-based display, and pictures are 20 times sharper than those on a typical computer display.

For Silicon Valley, the announcement bears a particular significance for the future of the Valley. Already the centre for software, microprocessor and other semiconductor industries, the establishment of a major flat panel facility in the Valley may well lead to the birth of yet another major high-tech industry in the area.

"The holy trinity of the digital area are software, semiconductors and displays. We already have two of them here. It is vital to the long term health of this region that we land the third as well," said Tom Hayes, chairman of Joint Venture Silicon Valley — the recently formed consortium that is working to ensure Silicon Valley remains the centre of US high-tech development.

At the Xerox announcement, the consortium showed off two models of its display, one black and white and the other colour.

Both measured 13 inches diagonally, and each consisted of 6.3 million pixels. That compares to 3.7 million pixels in a Sharp display that is regarded as the industry's most advanced. Most of today's laptop and notebook PC's use displays with less than one million pixels.

Malcolm Thompson, who is director of the electronic and imaging group at PARC, said the breakthrough was achieved in large part because of the use of advanced computer simulation technology and a 500-volt transistor PARC invented for the display. There were simply no existing transistors powerful enough to drive such a high density display.

Silicon Valley's husband and wife entrepreneural team of Bill Carrico and Judy Estrin are currently building up Network Computing Devices (NCD), which is already a worldwide market leader of the X-terminal market it pioneered. Earlier, they had turned LAN/WAN networking products marker Bridge Communications into a successful package which they sold to 3COM for US$70 million in 1986. Already NCD's sales have expanded to US$30 million a quarter.

New approach for video, CD retailing

Today's typical video rental and CD music stores are often crammed with endless product aisles and backrooms filled with piles of inventory. All that may soon be a thing of the past, thanks to a bold joint venture announced by IBM and Blockbuster Video, a major US video retail store chain.

Under the plan, consumers will be able to go into a video or music store, order a CD or video from a computerised catalog and pick up the product several minutes later — after it has been transcribed from a central digital entertainment library onto blank CDs or video cassettes at the local store.

Advantages of the technology are numerous. Retailers will save large sums in rental space, inventory costs, and shipping expenses. They'll also avoid losing sales to competitors when popular music or movie titles are sold or rented out.

Consumers will benefit from being able to purchase or rent any movie or album ever recorded. Today, most stores only carry a few titles from all but the biggest names in the music industry. While other selections can be special-ordered, the process often takes weeks.

IBM and Blockbuster said they want to jointly pursue this vision of high-tech entertainment retailing.

Under the terms of the agreement, IBM will help the joint venture, to be known as Fairway Technology Associates, develop the technology for the creation of massive digital entertainment libraries, as well as the systems for transmitting and recording the music and video.

Blockbuster will use the technology in its chain of more than 3500 video rental stores across the United States. IBM will be allowed to market the technology to other retailers as well.

Despite its promise, some big obstacles remain to be overcome by both IBM and Blockbuster. For one, Fairway will need to negotiate new agreements with most, if not all of the major entertainment companies (such as recording and movie studios) to get their permission to sell their titles in this revolutionary new way.

Already Sony officials said they were not interested in supporting the IBM-Blockbuster venture. While Sony officials conceded that IBM and Blockbuster are not out to engaged in illegal piracy practices, they said that any commercial copying is illegal and the company fails to see how consumers could benefit from in-store copying.

IBM officials said the company will only allow consumers to purchase copies of the original recordings. It would not allow consumers to create their own CDs by combining selected songs from different artists onto a single CD. That restriction could ease some fears among record industry officials.

IBM officials said that while initially their CDs would be sold at the same price as other CDs, eventually the price of the Fairway-based CDs and video tapes could be US$3-4 lower than the regular CDs and tapes because that much money is typically tied up in transportation costs.

Ashton-Tate ex-chief to head Creative Labs

Ed Esber, the deposed chief of Ashton-Tate is now back in the forefront of the personal computer market as he was appointed president of Creative Laboratories, the industry's leading vendor of audio and video multi-media boards for PCs.

Creative Labs is a San Jose-based subsidiary of the Singapore parent company. It has experienced explosive growth. During the first three quarters of its current fiscal year, the company has raked in US$204 million in revenues, 230% ahead of the pace a year ago.

Although Esber was responsible for turning Ashton-Tate into an industry leading vendor of database software products, he was also closely associated with the devastating decline of the company after running into stiff competition from Borland International, which acquired the company three years ago.

Creative Labs spokesperson Benita Kenn said that Esber's career should not be measured by the final two years at Ashton Tate. "He had five strong years during which he had quite an impressive track record. Esber has shown that he can take technology and position it with great success, a skill that will be especially helpful at Creative Labs."

Intel asks ITC to halt clone inputs

Facing an uphill battle in the courtroom against Cyrix and Advanced Micro Devices, Intel appears to be changing the strategy in its battle against 486 clone makers by aggressively seeking legal action against companies that are using non-Intel processors.

The company has asked the US International Trade Commission to prevent a Taiwan-based PC maker from importing its AMD based notebook computers into the United States.

According to Intel, Twinhead of Taipei is violating an Intel patent that covers the way a microprocessor interacts with memory chips on the same circuit board.

The technology is called 'paging' and involves the almost constant flow of data to and from the microprocessor and memory circuits. Intel said it received a patent for the paging technology in 1990 and is planning to enforce the patent against any company that produces computers with Intel-compatible microprocessors.

"We are serious. We think this is a very strong patent and we ought to get a return for our intellectual property," said Intel's chief legal counsel Thomas Dunlap.

At AMD and Cyrix, company officials said the Intel move represents an effort to scare their customers away by threatening legal action. Intel's action "is in character but inappropriate," said a Cyrix spokesperson.

Since Intel first announced it would seek licence agreement from AMD and Cyrix customers last year, only one company has entered into a licence agreement. AMD and Cyrix have urged their customers not to sign any such deals with Intel.

Both AMD and Cyrix say that their customers are protected against Intel through cross-licensing agreements.

At Twinhead, marketing manager Doug Moglin speculated why Intel singled out his company for its complaint with the ITC. In fact the move came somewhat as a shock to the company, which also buys chips from Intel. "We are a major customer of Intel's, which is what makes the matter so perplexing."

AT&T to put Photo CD into picture phone

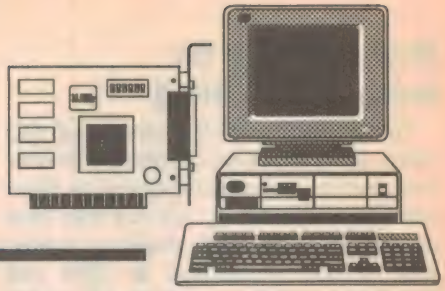
In yet another high-tech alliance with an eye on the future of multi-media data services, Kodak and AT&T have announced they will jointly develop a Photo CD system that would display full colour still images on televisions or computer displays over existing copper-based telephone wires.

AT&T said they will work with Kodak to incorporate Kodak's Photo CD technology into the AT&T Picasso Still-image Phone, which has just been introduced.

The Picasso Phone is capable of transmitting a full colour still image over the telephone in about 10 seconds. The system is price at US$3200.

The Picasso will be marketed towards engineers and other professions, who often need to transmit images to clients. AT&T wants to add Photo CD because of the system's ability to store up to 100 colour images into a single disk. ❖

Computer News and New Products



Local 'burning' of compact discs

The capabilities of Philips Compact Disc Interactive Support Centre at Homebush, Sydney now extend to the 'burning' of CD-ROM, CD-ROM (XA) and CD-I discs. Trials on all formats took place at the CD-I Support Centre earlier this year.

With the addition of a Philips CDD521 desk top recording system, this 'burning' facility is now available to local authors and program producers for test or completed software.

The Philips CD-I Centre, a marketing and technical support unit, promotes the use of CD-I and Photo CD for industry and education. While its mainstream authoring system is based on Optimages Media Mogul software, the centre will soon offer a broader range of authoring options, simultaneously at the creation, programming and 'burning' phases.

For further information circle 161 on the reader service coupon or contact Philips CD-I Support Centre, 3 Figtree Drive, Australia Centre, Homebush 2140; phone (02) 742 8266.

Compact PC mode chassis

Designed to withstand the demanding conditions of the factory floor and other harsh industrial environments, the PC-6806 Node Chassis serves in a wide variety of functions, such as an industrial PC, a wallmount PC controller, a run-only controller, a remote terminal unit for data-acquisition and control systems, and as an OEM PC enclosure.

A rugged and compact PC/XT/AT compatible system meeting the needs of system integrators, the IPC-6806 supports 80286, 80386 and 80486 plug-in cards.

One 3.5" floppy disk drive and one 3.5" hard drive are located on the underside of the lid, freeing up space for additional cards to be placed in the six-slot passive backplane. For maximum protection against equipment failure, a solid-state Flash/RAM/ROM disk card, such as Advantech's PCD-890, may be

installed. Installed cards are protected from vibration by a rubber buffered hold-down clamp.

At only 165 x 175 x 394mm, this compact unit takes up little room when used as a desktop unit. To conserve floor space, it can also be easily wall-mounted.

CD-ROM drives

The Panasonic range of CD-ROM disk drives comprises several models, featuring a fast access time of 290ms. They are available in AT-BUS or SCSI formats, and can be built-in or stand alone. Panasonic currently employs a caddy system, but expects to release tray-type CD-ROM drives also, later this year.

The biggest seller of the current range is the CR-522-B internal AT-BUS drive. It can be easily installed into a spare 5-1/4" floppy disk bay. Power is connected from the power supply and a 40-wire cable runs to either the controller card or directly to the sound card.

The CR-522-S is designed as a stand-alone unit, making it ideal for those situations where a 5-1/4" bay is not available,

or where a computer's power supply is inadequate to support another peripheral. It has a 64K buffer.

And to accommodate applications where more than one CD-ROM drive is required, Panasonic markets model CR-501 which allows up to seven drives to be linked together in a daisychain.

For further information circle 162 on the reader service coupon or contact Panasonic Australia, 1 Garigal Road, Belrose 2085; phone (02) 986 7400.

For further information circle 163 on the reader service coupon or contact Priority Electronics, 5/23 Melrose Street, Sandringham 3191; phone (03) 521 0266.

Loudspeaker design software

BassBox 4.0, from Harris Technologies, is an easy-to-use low frequency enclosure design program. This latest version is a Microsoft Windows application; and so it takes full advantage of that interface, with support for all graphics controllers, printers and pointing devices supported by Windows 3.1.

The system requirements for the software are a 386SX or better PC, with at least 2MB of free hard disk space and 4MB of RAM (recommended). Also required are a 1.44MB 3.5" floppy disk drive, a mouse, MS-DOS 5.0 and Windows 3.1.

The features of the package include: analysis of both small and large signals; plotting of the amplitude response and displacement-limited maximum acoustic power level; and the design of both closed and vented (with multiple ports) boxes. Band-pass, custom passive radiator and multiple woofer box designs are also supported.

Loudspeaker measured acoustical response can be entered and used when plotting the amplitude response, and multiple graphs can be overlaid for easy on-screen comparison. With suitable test equipment, including a sine wave generator and frequency counter, test procedures allow the user to calculate with precision loudspeaker and passive radiator parameters. And once you have decided on the design you will use, the Box Dimension Calculator computes the actual internal dimensions of the box, using its 15 different volume shapes database.

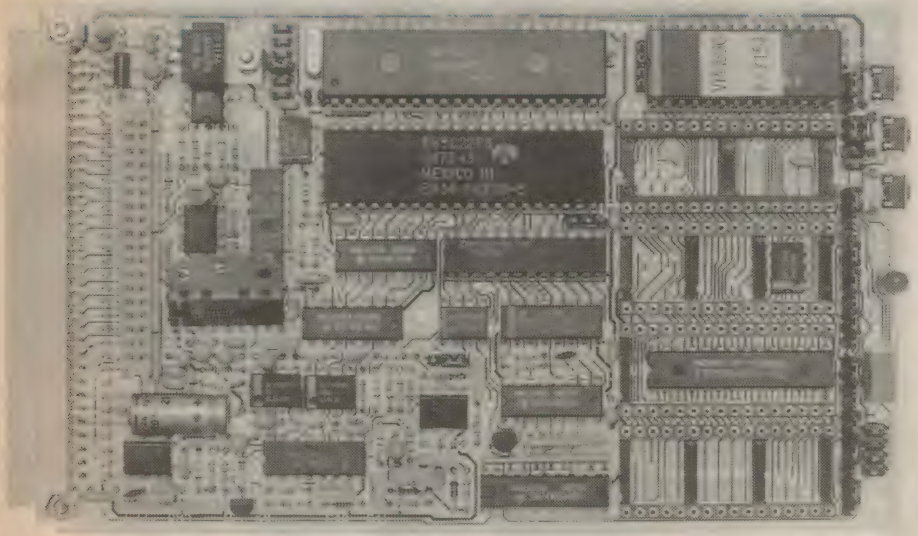
BassBox has a recommended retail price of $249. During its first few months on sale, it will come bundled with CALSOD 1.30. This offer requires the return of the BassBox registration form.

For more information circle 170 on the reader service coupon or contact Audiosoft, 128 Oriel Road, West Heidelberg 3081; phone (03) 499 3749, fax 497 4441.

Graphics accelerator cards

Recently released are new model Actix graphics accelerator cards for Windows and CAD applications, the *Graphics*ENGINE Ultra series. These cards complement the existing Actix *Graphics*ENGINE 32 range.

This addition to the Actix card range introduces the newest co-processor from S3, the 86C928. This super accelerator chip supports up to 4MB of VRAM and true colour support for 16.8 million colours at high refresh rates up to 1280 x 1024 resolution.



Single board voice computer

The MA590 single board voice computer (SBVC) is an intelligent voice output card that combines voice recording and playback with control functions. The card features memory sockets for up to 3 minutes of tape recorder quality of playback at 10kHz audio bandwidth.

I/O interfaces include audio input and output, 16 parallel I/O lines, RS232/RS485 port, I^2C Bus and optional music-on-hold input. Additional memory or I/O cards can be added to the MA590. For simple I/O expansion, a daughterboard with custom I/O can be placed piggyback on the card.

The MA590 includes a microprocessor and an EPROM-based voice processing monitor (VPM) firmward. VPM is a real-time multi-tasking operating system dedicated to voice processing, communications and control tasks. It provides all the functions necessary to develop custom sounds and speech in any language. The multitasking nature of VPM allows for control functions to be performed while playback is in progress.

The communication and control functions include XMODEM file transfers and drivers for I^2C Bus devices. VPM also includes a simple programming language, called 'Voice', optimized for applications requiring voice output and control functions.

The MA590 can be used in a standalone mode running user control program, or its functions can be controlled from a host computer via the serial interface. Programming and custom voice development is achieved by connecting the MA590 to the PC serial port. If FLASH memories are used, they can be programmed directly on board the MA590.

For further information circle 166 on the reader service coupon or contact Microcontrol (Australia), PO Box 1020, Pymble 2073; phone (02) 449 1546, fax 488 7719.

The '928 processor incorporates an internal 32-bit bus design on the Actix *Graphics*ENGINE Ultra, with linear address mapping for faster memory-to-screen operations. Its shared memory architecture provides support hooks to a video co-processor for full motion video.

Five models of the Actix *Graphics*ENGINE Ultra are available. They range from the ISA bus 1MB model up to the 4MB VL VESA local bus model. All cards support the new higher refresh rate of 75Hz, as indicated by the IBM XGA-2 standard. They are ideal for use with new generation monitors from NEC and others.

Actix claim an overall speed improvement of 300% in Windows performance when using the new *Graphics*ENGINE Ultra card. All cards come complete with software drivers for Windows and DOS applications and an Aquila Display List Processor suitable for AutoCAD. Drivers can be upgraded at any time from the Sprinter Bulletin Board. List prices range from $682 for the 1MB ISA version, to $1664 for the 4MB VL local bus card (all prices include tax).

For further information circle 167 on the reader service coupon or contact Sprinter Products, 22 Darley Road, Manly 2095, phone (02) 977 8155, fax 977 8175.

Enhanced simulation on the Macintosh

The latest version of Intusoft's CAP/4M package for the Macintosh includes three powerful new functions that greatly augment its circuit simulation capabilities. They include Monte Carlo statistical yield analysis, parameters sweeping, and circuit optimisation. The new capabilities are part of the PreSpice module in the ICAP/4M system.

Intusoft has instituted a flexible Monte Carlo syntax that allows virtually any simulation value (model, component, source, etc.,) to have a tolerance. Both lot and device tolerances may be specified, and tolerances may be interdependent and scalable.

Curve families are automatically saved without any user interaction required, so that, after the analysis is complete, both probability and histogram graphs can be used to analyze the results.

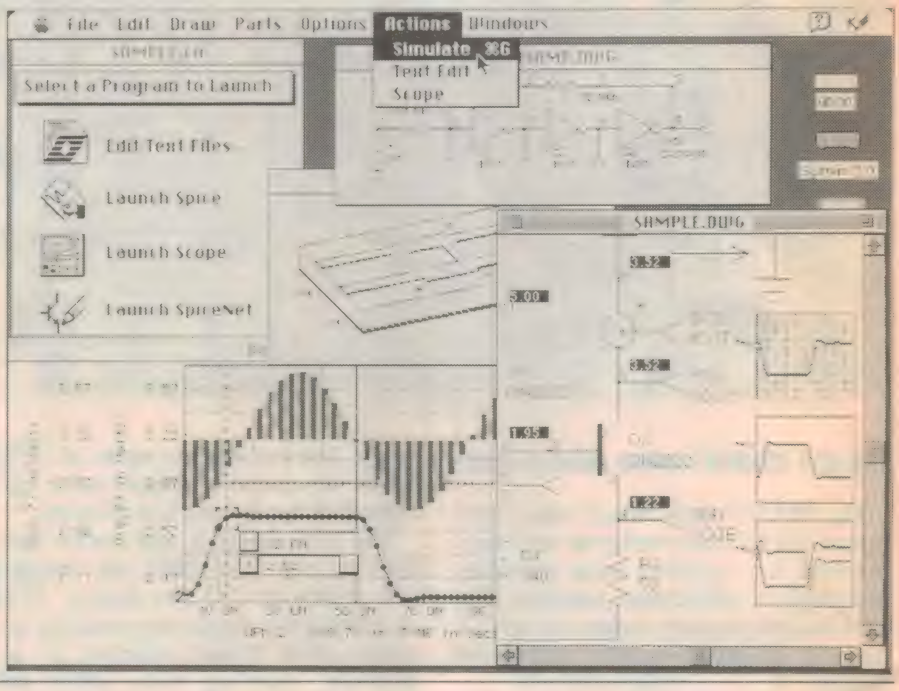
Another new function, the Intusoft Circuit Optimizer, is also available. The circuit optimizer automatically finds the value of any simulation variable (component/model/source parameter) that produces a maximum or minimum value of a user defined objective function.

Any circuit parameter may be optimized for virtually any objective function, such as bandwidth, rise time, or power dissipation. The difference between the sweeping capability using the circuit optimizer and the sweeping features in standard SPICE is that the circuit optimizer is not limited to any component values. Any numerical value in the SPICE netlist may be swept.

The PreSpice module in the ICAP/4M system greatly facilitates the use of any SPICE simulator. It combines the new functions discussed previously with model libraries, modelling utilities, and a sophisticated netlist editor under one simple-to-use environment.

The SPICE model libraries in PreSpice offer an extensive array of electronic components — over 1200 models for specific components and over 100 generic template models. All of the models are strictly Berkeley SPICE compatible and are guaranteed to run on any SPICE 2G.6 or SPICE 3E.2 compatible program on any computer platform.

For further information circle 165 on the reader service coupon or contact ME Technologies, PO Box 50, Dyers Crossing 2429; phone (065) 50 2254. ❖



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READER INFO NO. 30

EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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A Kits and modules
B Tools
C PC boards and supplies
D Components
E IC chips and semiconductors
F Test and measuring instruments
G Reference books

Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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ADVERTISING INDEX

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MINI EL-CHEAPO LASER KIT

The smallest and most efficient tube — invertor kit combination we ever offered. The used laboratory quality 1mW tube is 155mm long and has a diameter of 25mm, and the power supply would occupy a similar volume. The switched mode supply is very efficient! Draws approximately 600mA from a 12V battery, and it could be easily modified for operation from lower and higher DC voltages. A very compact combination that produces a very bright and low divergence beam. Great for portable use. Incredible pricing:

$60

for the tube, the inverter kit and the instructions.

IR BINOCULARS

High quality helmet mount, Ex-Military binocular viewer. Self powered by one 1.5V, "C" size battery. Focus adjustable from 1 metre to infinity. Requires IR illumination. Original carry case provided. Limited stocks, ON SPECIAL AT:

$500

HIGH POWER TRIACS

We have a limited quantity of some 60A-600V stud mounted triacs: Type TGAL606. Grab them while they last at a fraction of their real value. ONLY:

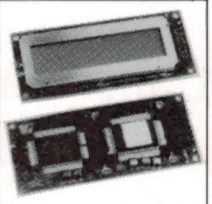
$10.50

TV TUNERS

These famous brand TV tuners were intended to convert some colour computer monitors to COLOUR TV recievers: The monitors that have a composite video input, not the RGB types. They contain all of the ncessary signal processing and channel switching: Antenna IN, to Composite video and line level audio output. They are a commercial product which is completely enclosed and mains powered. The channel is selectable by 12 illuminated pushbutton switches and seperate preset adjustments allow each of the pushbutton to access any channel in the VHF-UHF range. Supplied with a "rabbit ears" antenna. A circuit for the unit is provided. We should have more information and circuits, showing how to convert the composite video output to an RGB output, convert this unit to a Stereo TV tuner. LIMITED SUPPLY.

$139

LCD CHARACTER DISPLAYS



We sold out of these new 16 character by 2 line alphanumeric LCD display modules, but have obtained new stocks recently. They have surface mount control circuitry mounted on the rear of the display, and only require a few mA at 5V to operate: Information included. Although they have different pin positioning they can be used directly with the project published in S.C., entitled ALPHANUMERIC LCD DISPLAY BOARD: See S.C. May 93 issue. New units at about ½ of their real value:

$18 or 5 for $80

LED BRAKE LIGHT INDICATOR KIT

This "brilliant" brake light indicator employs 60 high intensity LED's (550-1000mCD) to produce a display that is highly visible, even in bright sunlight. The intensity produced is equal to or better than the LED brake indicators which are now included in some late model "upmarket" vehicles. The LED displays used in most of these cars simply make all the LED's turn ON every time the brakes are applied. We offer a kit that will produce equal if not better results to this type of display for:

$47

Another version of the kit can also be customised to produce a number of sweeps (1-10) starting at the centre of the display, and with a variable sweep rate: It not only looks spectacular but also attracts more attention:

$65

Both of the kits are supplied with a PCB and all the onboard components: Yes, they both include 60 high intensity LED's. **For more information see the Aug. 93 edition of S.C.**

CRYSTAL OSCILLATOR MODULES

These small TTL Quartz Crystal Oscillators are hermetically sealed. Similar to units used in computers. Operate from 5V and draw approximately 30mA. TTL logic level clock output. Available in 4MHz, 4.032MHz, 5.0688MHz, 20MHz, 20.2752MHz, 24.74MHz, 40MHz, and 50MHz.

$7 ea. or 5 for $25

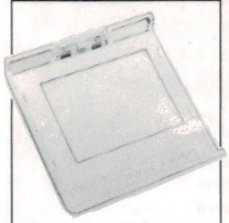
STEPPER MOTOR

These are brand new units, main body has a diameter of 58mm and a height of 25mm. Will operate from 5V, has 7.5deg. steps, coil resistance of 6.6 ohms, and it is a two phase type: Six wires. ONLY:

$12

Suitable driver IC and circuit: **$9**

FLOURESCENT BACKLIGHT



These are new units supplied in their original packing. They were an option for backlighting Citizen LCD colour TV's. The screen glows a brilliant white colour when the unit is powered by a 6V battery. Draws approximately 50mA. The screen and the inverter PCB can be separated. Effective screen size is 38X50mm.

$12

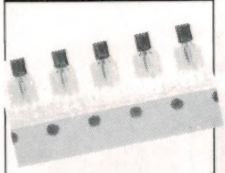
MASTHEAD AMPLIFIER KIT

Based on an IC with 20dB of gain, a bandwidth of 2GHz, and a noise figure of 2.8dB, this amplifier kit out performs most other similar IC's and is priced at a fraction of their cost. The cost of the complete kit of parts for the masthead amplifier PCB and components and the power and signal combiner PCB and components is PRICED AT AN INCREDIBLE:

$18

For more information see a novel and extremely popular antenna design which employs this amplifier: MIRACLE TV ANTENNA — E.A. May 1992: Box, Balan, and wire for this antenna: $5 extra.

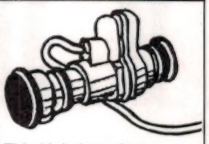
BC548 TRANSISTORS



Brand new Philips brand BC548 transistors with in line leads and taped to a cardboard strip. Designed for automatic insertion machines. Leads are spaced by 3.5mm and 13mm long. A BARGAIN:

$6 for 100

PASSIVE NIGHT VIEWER KIT



This kit is based on a BRAND NEW passive night vision scope, which is completely assembled and has an EHT coaxial cable connected. This assembly employs a high gain passive tube which is made in Russia. It has a very high luminous gain, and the resultant viewer will produce useful pictures in sub-moonlight illumination. The viewer can also be assisted with Infra Red illumination in more difficult situations. It needs an EHT power supply to make it functional, and we supply a suitable supply and it's casing in kit form. You would pay more than twice this price for a monocular Russian viewer that employed a similar tube! This would probably represent the best value NEW viewer that we ever offered!

$550

5" COLOUR MONITOR

These brand new open frame construction 5" COLOUR MONITORS have a flat faceplate, 640 X 200 dot resolution, CGA and hercules compatible, standard interface connector, degaussing coil included, 12V DC operation, 15.75KHz horizontal frequency, 60Hz vertical frequency. These frequencies are both adjustable to the Australian standard TV frequencies: Information supplied. Use them for computer monitors, experimenting, education, disco displays etc. etc. Don't miss out on this BARGAIN!:

$149

X-Y SCANNER — ERRATA

All the purchasers of our previously advertised X-Y laser scanner kit ($44) please not two important corrections, without which improper operation would result. ... As per the circuit diagram pin 7's of both the LM380 amplifiers should be grounded, but on the PCB they are not grounded: Missing track. ... Parasitic oscillations could result unless 680pF capacitors are not soldered across R12 and R13. Now you are ready to see this unit perform!

68W SWITCHING POWER SUPPLY

115-230V AC input, 5V at 4A and 12V at 4A output. Brand new, very compact: 140 X 82 X43mm. UNBELIEVABLE PRICE:

$28 ea. or 2 for $50

FLOURESCENT LIGHT INVERTER

At the heart of this kit is a flourescent light inverter capable of powering 4-20W flourescent tubes. It also has control inputs that enable it to be switched from a movement detector. We also supply a crystal controlled ultrasonic movement detector and an incadescent lamp switch — flashing circuit. Even the ultrasonic transducers are included. Three seperate kits that can have many applications for a total reduced price of:

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ON SPECIAL FOR TWO MONTHS!

See "Multifunction flouro light". E.A. NOV. 92.

SOME DIFFERENT COMPONENTS

1000pF/15KV Disc ceramic capacitors

$5

20KV PIV-5mA Av./1A Pk. Fast diodes

$1.50

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$0.60

WO4 1.5A-400v Bridge rectifiers

$0.60 ea. or 10 for $5

0.01uF/5KV Disc ceramic capacitors

$1.80

680pF/3KV Disc ceramic capacitors

$0.30

Schottky Barrier diodes 30V PIV-1A/25A Pk.

$0.45

100 LED BARGRAPH DISPLAY Yes 100 LED's, plus IC control circuitry, all surface mounted on a long strip of PCB. SIMPLE, a 4 bit binary code selects which one out of the 10 LED groups will be on, whilst another 4 bit binary code selects which one of each group of 10 LED's will be ON. Latching inputs are also provided. We include a circuit and a connecting up diagram. VERY LIMITED QUANTITY

$7

SPEAKER GIVEAWAY

One 3" tweeter, one 4" woofer, a non polarized crossover capacitor, plus a diagram:

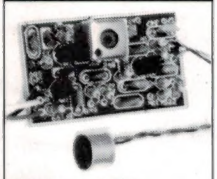
$10 for the set

2 sets (STEREO) for

$18

We don't have much more information on these new components that appear of high quality. The tweeter alone is worth over $12.

FM TRANSMITTER KIT — MK11



This low cost FM transmitter features pre-emphasis, high audio sensitivity as it can easily pick up normal conversation in a large room, a range of well over 100 metres, etc. It also has excellent frequency stability: The resultant frequency shift due to waving the antenna away and close to the human body and/or changing the supply voltage by +/– 1V at 9V will not produce more than 30KHz deviation at 100MHz! That represents a frequency deviation of less than 0.03%, which simply means that the frequency stays within the tuned position on the receiver.

Specifications: Tuning range: 88-108mHz, Supply voltage 6-12V, Current consumption at 9V: 3.5mA, Pre-emphasis: 50uS or 75uS, Frequency response: 40Hz to greater than 15KHz, S/N ratio: Greater than 60dB, Sensitivity for full deviation: 20mV, Frequency stability (See notes): 0.03%, PC.B. dimensions: 1" X 1.7".

Construction is easy and no coil winding is necessary: The coil is preassembled in a shielded metal can. The double sided, solder masked and screened PCB also makes for easy construction. The kit includes a PCB and all the on-board components, an electret microphone, and a 9V battery clip:

$11 ea or 3 for $30

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